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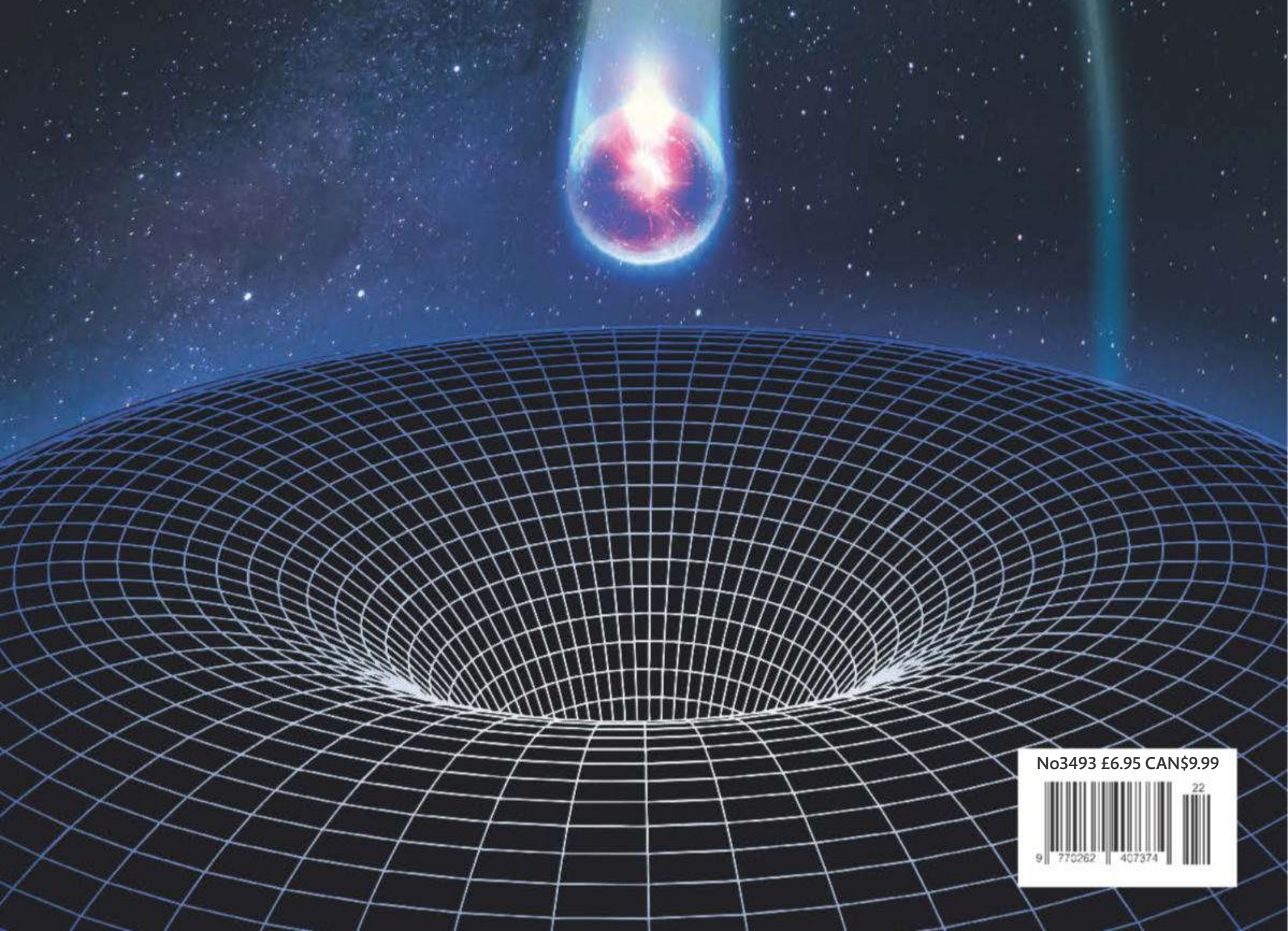

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New Scientist Live

Among other great speakers at this year's festival, hear cosmologist Jo Dunkley talk about the state-of-the-art telescopes in Chile that are allowing us to study light coming from the earliest moments of the universe. This research is helping solve some of the mysteries of dark matter. Join us in person at New Scientist Live on 13 October at London's ExCeL Centre.

newscientist.com/nslmag

Tour

Niels Bohr's Copenhagen

Join journalist Manjit Kumar on a journey to the birthplace of quantum physics. Explore the sites where Niels Bohr formed his ideas about atomic structure and quantum theory, and find out how he became part of the Manhattan Project, which made the atomic bomb. Then enjoy a day trip to the ancient city of Roskilde – now a centre for sustainable energy research. This six-day tour starts on 3 July and costs £2698.

newscientist.com/tours

Podcast

Weekly

This week, the team discuss the truth about the sun's magnetic field and get the lowdown on a mysterious element called promethium, which we have been struggling to study for nearly 80 years. Plus: hear why one of our reporters has been role-playing as an ancient Greek warrior and why the Atlantic hurricane season is projected to be so bad this year.

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AMAR AND ISABELLE GUILLEN - GUILLEN PHOTO LLC/ALAMY

Kelping hand Seaweed can harvest rare elements from the sea

ALMA (ESO/NAOJ/NRAO)/W. GARNIER

Dawn of time ALMA telescopes look back to the start of the cosmos

Video

The joy of plants

As a botanist, one of James Wong's firmest beliefs is that plants improve our quality of life. In one of our latest videos, he explores why we get a feel-good factor from being outdoors. "Stepping into green space can make you immediately feel better," says Wong. Watch this and many more mind-expanding videos and short films online now.

youtube.com/newscientist

Newsletter

Fix the Planet

The transition away from fossil fuels will require vast quantities of rare metals and other elements to build green technologies like batteries and solar panels. In his latest missive, James Dinneen explores how we might get them from seaweed. Sign up to get the newsletter in your inbox for free, every month.

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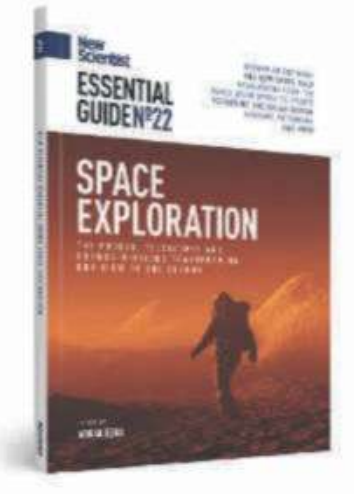
Podcast

"Earth's crust has so little promethium because every form is highly radioactive"



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Can you help the gibbons survive in their natural habitats?

Build THE Change

New Scientist and The LEGO Group's free social impact program, Build the Change, have teamed up to launch a competition to help gibbons survive in their fragmented forests. Open to UK residents* aged 11-14 the challenge is to design a solution to help gibbons navigate the threats they are facing.

With separate categories for schools and the general public, you can enter the competition for a chance to win some amazing prizes, including the opportunity to work with LEGO® Master Builders to turn your design into a LEGO model at New Scientist Live, with your design potentially inspiring a working prototype built by engineers from Imperial College London.

For more information and to take part visit:
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A pivotal moment

The end of El Niño should be a spur for accelerated climate action

THE past few years have seen a significant rise in inflation in many countries, driven by a range of factors from pandemic-fuelled shortages to the war in Ukraine. But even now, as inflation is falling, prices are still rising, albeit more slowly. This subtlety is often missed, intentionally or otherwise, by politicians seeking to claim victory over inflation.

Don't worry, you haven't accidentally started reading *The Economist*. The point is that we may soon see a similar effect in the global climate. As we report on page 8, the El Niño climate pattern is about to come to an end. Just like the recent inflationary period, El Niño has seen graphs soar, with a nearly year-long streak of record-breaking temperatures.

The trouble is, just as prices continue to rise when inflation falls, the carbon dioxide we have pumped into the atmosphere will keep pushing up temperatures, even without the influence of El Niño. While coming years may be cooler, overall, the planet is still warming at an alarming rate.

"While coming years may be cooler, overall, the planet is still warming at an alarming rate"

Precisely how close we are to exceeding 1.5°C above pre-industrial temperatures, a key limit to avoid the worst consequences of climate change, is hard to assess. Traditionally, climate scientists look at this over decades, meaning we would only confirm a breach in retrospect.

There is some good news here at least, as a new analysis shows that we can simply count the number of years in which average global temperatures exceed 1.5°C (see page 9). It found that just three years above 1.5°C is enough to confirm a breach. The bad news is that 2024 may be the first.

As we have said many time before, despair isn't the answer. Unlike inflation, climate spikes are somewhat predictable. The next El Niño is likely to occur between two and seven years from now, so almost certainly within this decade. Before it comes, bringing yet more heat, the world should use this period to finally bend the curve on carbon emissions with a proper push for net zero by 2050. We will all benefit – and politicians might have something real to celebrate. ▮

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Astronomy

Most detailed shot of a star nursery

This stunning image, captured by the Euclid space telescope, shows star-forming region Messier 78. Newly launched Euclid is much more sensitive than previous telescopes, and this image revealed more than 300,000 new objects, most of them newborn stars. This and 16 other images were all taken in just 24 hours of observation, so Euclid's sky map after its six-year run should be breathtaking.

Record weather

As warm El Niño ends, what next?

After a year of driving extreme weather, the El Niño pattern in the Pacific Ocean is subsiding, but this year may not be any cooler, says **James Dinneen**

THE El Niño climate pattern is coming to an end after boosting record temperatures and extreme weather across the planet over the past year. But it is uncertain how soon a transition to a cooler La Niña will bring respite from the heat.

"La Niña should stop that streak of record-breaking temperatures," says Pedro Dinezio at the University of Colorado Boulder. "If it doesn't, are our models wrong? Are we underestimating global warming?"

El Niño conditions are characterised by above-average sea surface temperatures in parts of the tropical Pacific. These waters usually oscillate between a warm El Niño temperature pattern, neutral conditions and a cool La Niña every two to seven years, a cycle that is one of the strongest factors influencing the global climate. El Niño is associated with hotter average temperatures and a distinctive pattern of weather conditions in much of the world.

The current El Niño first appeared in June 2023, following a rare three-year-long La Niña. Temperatures in the Pacific Ocean are now expected to return to neutral conditions within the next month, according to the latest forecast from the US National Oceanic and Atmospheric Administration (NOAA). Cool La Niña conditions are then likely to appear between June and September.

"You can already see [La Niña] emerging," says Dinezio. "You can see it there in the Pacific right now."

Early last year, researchers were alarmed that the developing El Niño might reach historic strength, comparable to the powerful ones of 2015-2016 or 1997-1998. A very strong event could have an outsized influence on weather around the world.

AP PHOTO/ESTEBAN FELIX/ALAMY

Wildfires in Chile this February may have been worsened by El Niño

What emerged was a strong El Niño – the temperature anomaly in the Pacific reached 2°C above average at its peak – but not a record-breaking one. However, combined with background global warming from human-caused climate change and other factors, the outcomes of this year's El Niño were unprecedented.

The heat pouring out of the Pacific helped make global average temperatures in 2023 the hottest on record, with shocking heat anomalies on land and in the oceans. Each of the past 11 months since El Niño emerged has also been the hottest of that month on record, according to NOAA.

Global trade disruption

Many of the regions that normally see weather influenced by El Niño also saw those effects amplified by background warming. For instance, drought and heat drove intense fire seasons in South America and Indonesia. In Central America, low water levels linked to El Niño created a traffic jam in the Panama Canal, disrupting global trade. Heavy precipitation caused flooding from California to Afghanistan.

Not all these effects were entirely negative. In the Horn of Africa, for instance, the rain helped ease a drought that has contributed to near-famine conditions in the region.

> "This was an El Niño superimposed on global warming in a way we have never seen before"

But the overall damages of this El Niño will probably last for years, says Christopher Callahan at Stanford University in California. Past El Niño periods have been linked to trillions of dollars in damages and persistent economic losses, especially in low-income countries in the tropics. "This was an El Niño superimposed on global warming in a way we have never seen before," says Callahan. "A lot of the global impacts we saw, it's still hard to disentangle."

Even as the usual pattern of El Niño's influence emerged, other places saw extreme weather that fell outside the norm. For instance, the Mediterranean isn't sensitive to El Niño, but last September, it saw torrential rain that led to a catastrophic dam collapse in Libya. And ocean temperatures in the Atlantic reached record high levels even before El Niño developed.

Dinezio says this suggests the impact of background warming on the climate may be growing to match the influence of the El Niño cycle for the first time. "Last year, those two had equivalent influence," they say. There is some evidence that these forces were actually working against each other in certain locations.

The rapid shift to La Niña conditions, which isn't unusual following a strong El Niño, could help moderate global average temperatures – although this won't happen immediately. "There's still going to be a lag in the climate system, and certainly in the global oceans," says Karin Gleason at NOAA. Historically, the year after El Niño develops is hotter, and 2024 is still expected to break 2023's heat record.

But the end of El Niño will help researchers understand how much of the past year's heat can be attributed to its influence, as opposed to background global warming or factors such as the 2022 eruption of Hunga Tonga-Hunga Ha'apai. This could help resolve an ongoing debate among researchers about whether 2023's off-the-charts temperatures suggest climate change is accelerating faster than models projected.

"A clear answer from La Niña should help us tease that out," says Dinezio. ▮

Climate change

Just three years of high temperatures will mean we have missed 1.5°C goal

Madeleine Cuff

THE world seems to be getting ever hotter, but how will we know when we have missed the target of limiting global warming to 1.5°C? Just three individual years of high global average temperatures will be enough, a new analysis reveals.

In the 2015 Paris Agreement, almost every nation in the world signed up to an international treaty promising to limit any hike

1.44°C

The amount 2023 surpassed pre-industrial temperatures

in global average temperatures to "well below" 2°C above pre-industrial levels, and to aim for just 1.5°C of warming.

Since then, the 1.5°C goal has become the focus of global climate ambition, even as continued greenhouse gas emissions make it unlikely it will be achieved. Human activities have already increased average global temperatures by 1.26°C above pre-industrial levels, with some years already coming close to 1.5°C of warming.

Most ways to calculate a breach of the Paris temperature limits rely on decades of data to discern the state of the climate in order to iron out short-term blips. This means we may only know a target has been missed 10 years after the fact.

But now, Lawrence Jackson at the University of Leeds, UK, and his colleagues have for the first time identified that temperature data for individual years can provide an indication the world has passed 1.5°C in almost real time. They combined analysis of historical temperature records with modelling data to predict future temperatures and year-by-year variation (Research Square, doi.org/mxnn).

"We've helped to throw a light on the relationship between annual temperature changes and the long-term Paris Agreement temperature change," says Jackson.

If average annual temperatures run at or more than 1.5°C above pre-industrial levels for three years, whether those years are consecutive or not, it is almost certain the world has breached the lower goal of the Paris Agreement, says Jackson.

The first annual breach may already be imminent. Last year saw record-breaking heat, with average temperatures running 1.44°C above pre-industrial levels (see graph, right). That was in part due to a major El Niño event (see story, opposite). The extraordinary run of high temperatures has continued into 2024, with this April the hottest on record.

Meanwhile, the global average for the past 12 months is also the highest on record, running at 1.6°C above the 1850 to 1900 average, the period used to gauge the pre-industrial temperature.

It is "conceivable" that 2024 could be the first year to breach 1.5°C of warming, says Jackson, leaving just two more years of breaches until the target is missed. Most climate models expect the 1.5°C threshold to be exceeded at some point in the early 2030s, unless the world makes fast, dramatic cuts to emissions.

Annual global average temperature rise relative to 1850-1900 (°C)

CHART:NEW SCIENTIST;SOURCE:HADCRUT5

Joeri Rogelj at Imperial College London says the analysis, which hasn't yet been peer reviewed, "provides a relatively fast indicator to determine with high certainty that we have crossed the 1.5°C global warming limit".

Richard Betts at the University of Exeter, UK, says the work is "very interesting". But he suggests scientists should agree on one methodology to judge progress against the Paris Agreement, to avoid any technical arguments "distracting" attention from climate action.

Any breach of the Paris goals is likely to provoke a huge outcry, particularly from nations most imperilled by rising temperatures. Camilla Born, who has advised the UK government during international climate negotiations, says the ability to identify a breach of 1.5°C in real time could "force a reckoning" in international talks, intensifying disputes over issues such as climate reparations.

But she says the 1.5°C target will remain as a "political slogan" because many countries have shaped national climate targets around the goal. As a result, there may be more focus on carbon removal strategies, with the aim of bringing global average temperature rise back down to below 1.5°C in the long term.

"I don't think we will get away from 1.5°C. I still think it will be an important part of the political conversation," she says.

Karsten Haustein at Leipzig University in Germany says the work takes a "neat approach". However, he stresses that 1.5°C is an "arbitrary target" that is almost guaranteed to be breached. What matters more, he says, is to what extent the world can limit warming to below 2°C. "Every tenth of a degree centigrade past this 1.5°C threshold, that matters as much as this 1.5°C threshold," he says. ▮

DANIEL CARDENAS/ANADOLU VIA GETTY IMAGES

Cities in Mexico have registered record high temperatures this month

Palaeontology

Ancient egg-laying mammals revealed

Trove of Australian fossils offers a rare glimpse of the ancient relatives of platypuses and echidnas that lived alongside the dinosaurs 100 million years ago, finds **James Woodford**

L: PETER SHOUTEN; R: JAMES WOODFORD

Illustration of six ancient monotreme species (left) whose fossilised remains were found at Lightning Ridge in Australia. Above is the fossilised jawbone of one of these monotremes

FROM inside an old safe in the Australian Museum in Sydney, palaeontologist Tim Flannery carefully removes a shoe-box-sized container and places it on a table. Inside are more boxes and containers, like a Russian doll.

Once the contents are revealed and spread out, there are nine tiny fragments of fossilised jawbones. If Flannery and his colleagues are right, before us is a glimpse of a previously unknown chapter of mammal history. Flannery tells me the fossils "represent the first glimmerings we have of the age of monotremes".

Today, these egg-laying mammals have been almost completely replaced by marsupials and placental mammals. Only two families survive: the platypuses and the echidnas, and they are restricted to Australia and the island of New Guinea.

The fossils I am looking at were collected in the opal-mining town of Lightning Ridge in New South Wales. They have been in the Australian Museum's collection for decades but have only now been classified and studied.

According to Flannery and his colleagues, all nine of these fossils are from monotremes, including three new species. They all lived alongside the dinosaurs 100 million years ago.

The work doubles the number of known monotreme species identified at Lightning Ridge from three to six. One fossil that Flannery is holding, collected by an opal miner in the mid-1980s and named *Steropodon*, was part of a small tranche regarded as so precious that the Australian Museum purchased it for A$80,000.

The fossils are made of opal, formed when silica dissolved in water fills a cavity in rock left by bone after it has rotted away.

When the deposits were laid down in the Cretaceous Period, 100 million years ago, Australia was part of the supercontinent of Gondwana, and Lightning Ridge would have been rainforested and swampy. The opals of Lightning Ridge have yielded dinosaur, reptile and fish fossils,

"Maybe it ate worms that it slurped in. It's a really weird creature and a bit of an enigma"

but no mammals other than monotremes have been found.

One of the big mysteries of monotreme evolution is when platypuses and echidnas diverged from a common ancestor. Genetic evidence suggests this happened some 50 million years ago.

One of the newly identified species, *Opalios splendens*, shares traits with both echidnas and platypuses, resulting in the nickname "echidnapus". It has been placed in a new family named Opalionidae.

Platypuses can detect electric fields with their bills, and this helps them to find prey underwater. The echidnapus has canals in its jaw similar to those in platypuses, which carry blood vessels and nerves that enable its electric sense, and the jaw is twisted like that of a platypus. But the beak is narrow and the jaw articulation is long, like that of an echidna (*Alcheringa: An Australasian Journal of Palaeontology*, doi.org/mx7q).

"We can see it had electroreception," says Flannery. "But I can't see how it opened its jaws. Maybe it ate worms that it slurped in. It's a really weird creature and a bit of an enigma."

Despite similarities to both echidnas and platypuses, Flannery says it is impossible to know if *O. splendens* is a direct ancestor of living monotremes because it lived long before genetic evidence suggests the two groups diverged.

Another fossil, *Dharragarra aurora*, has a jaw that is similar to that of a modern platypus. The other specimens are from animals that probably ranged from the size of a small possum to the size of a cat, says Flannery.

The researchers also point out that four of the six Lightning Ridge monotreme species have been identified from single fossil specimens, implying that there is enormous undiscovered diversity.

"If we keep finding more material, then we'll keep finding more species," says Flannery. "This will be the last time that anyone comes across an unknown age of mammal evolution."

Kris Helgen, who also worked on the study at the Australian Museum, says it is a big deal to name and describe a new mammal family. "In Lightning Ridge, we see monotremes with teeth [which are absent in modern monotremes] and we have lots of different ways to be a monotreme all living together. It takes 40 million years to birth a mammal family, so these discoveries speak to the fact that there's already been a long depth of evolution at Lightning Ridge."

The paper proposes some interesting scenarios, says Aidan Couzens at Flinders University in Adelaide, Australia, including that Australia's mammal fauna was dominated by monotremes during the age of dinosaurs before later being usurped by marsupials. ▮

Astrophysics

Tiny black holes could trace patterns inside the sun

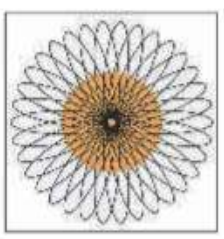
Leah Crane

OUR solar system might be full of tiny black holes, with some following beautiful, Spirograph-like orbits inside the sun.

Invisible dark matter seems to account for the vast majority of mass in the universe, but we don't know what it is. Hypothetical black holes that formed shortly after the big bang, called primordial black holes, are one dark matter candidate. If they do exist, our solar system should be full of them.

David Kaiser at the Massachusetts Institute of Technology and his colleagues simulated what the orbits of tiny black holes around, and within, the sun or a similar star might look like. For primordial black holes to account for the effects of dark matter, each, although very small, must have a mass of between 100 billion and 100 million billion tonnes.

Because the sun is the most massive object in our solar system, it would probably capture some of these black holes. The tiny black holes, each moving at hundreds of kilometres per second, could then make hundreds of orbits through the sun before they collide with any significant amount of matter.



VITORIO A. DE LORENCI

Primordial black holes could take on intricate orbits inside the sun and similar stars

Kaiser and his colleagues' research suggests that the orbits of these holes could trace out all sorts of patterns, from simpler circles to more elaborate patterns, as in the picture above (arXiv, doi.org/mxr2).

Unfortunately, we will never be able to observe primordial black holes in the sun. But if they lurk elsewhere in the solar system, we may be able to spot the way they make other objects wobble. ▮

Health

Antiviral drug may offer treatment for hearing loss

David Cox

THE antiviral medication Tamiflu seems to ease noise-induced hearing loss in mice. If the same thing happens in people, this could open the door to a treatment for a common type of deafness.

Noise-related hearing loss affects approximately 5 per cent of people worldwide. Prevention focuses on just avoiding loud sounds where possible, and treatments are limited to hearing aids and implants.

Only one drug, sodium thiosulphate, has ever been approved to prevent any type of hearing loss. It was given the green light by the US Food and Drug Administration (FDA) in 2022, but it is only available for children taking a form of chemotherapy called cisplatin, which can damage the ear by inducing cell death.

Drug library

Seeking more options, Emma Sailor Longsworth at Creighton University in Nebraska and her colleagues have worked their way through a library of 1300 drugs that had been FDA approved to protect against cisplatin damage to any part of the body.

The researchers tested whether any of these drugs shielded inner ear cells from harm in test tube experiments, which led them to oseltamivir phosphate, which is better known as Tamiflu.

To assess whether oseltamivir phosphate might treat noise-induced hearing loss, the team placed mice into a sound-tight chamber and exposed them to 100 decibels of noise – equivalent to the sound of a relatively quiet bulldozer or motorcycle – over 2 hours.

The mice were then split into four groups, three of which received varying doses of oseltamivir phosphate within 24 hours of noise exposure, while the fourth group acted as a control.

Compared with the control group, the mice that received the highest dose of the drug had less diminishing of their auditory brainstem response, defined as the activity level of a pathway of neurons that connects the inner ear to the brain's major hearing hub, called the inferior colliculus. Lower doses were less effective.

Through a series of further experiments, the researchers found that oseltamivir phosphate protects against cochlear synaptopathy. This is a loss of synapses – the points at which neurons connect and communicate – in the auditory nerve pathway that links inner ear cells to the brain.

They also found that the drug lowers levels of CD45 immune cells, markers of inflammation that become elevated following noise exposure. Its anti-inflammatory properties also suppress levels of a protein called ERK1/2, which is associated with inflammation in cisplatin and noise-induced hearing loss (bioRxiv, doi.org/mxqx).

"While promising, it is a study in mice and so the drug effects in humans would need to be established before we can get excited about its potential to reduce or prevent hearing loss," says Julia Sarant at the University of Melbourne, Australia. "But if they cross over, this treatment could prevent significant suffering and disability for many people."

1300

Number of drugs assessed to see if they would help hearing

However, very distinct biological processes underlie different forms of hearing loss, and oseltamivir phosphate may not be appropriate for all of them, says Sarant. "Cardiovascular disease causes hearing loss by restricting blood supply to the ear and it seems unlikely that Tamiflu could address this," she says. ▮

Tamiflu is an antiviral drug that is ordinarily used against flu

CTK PHOTO/MARTIN STERBA/ALAMY

Technology

AI can guess where landmines are most likely to be hiding

Matthew Sparkes

AN ARTIFICIAL intelligence can predict the location of landmines with up to 92 per cent accuracy, making removal of the deadly devices faster and more efficient, say researchers.

Some 60 countries around the world are contaminated by landmines and the weapons are being buried in war zones like Ukraine faster than they are disarmed elsewhere. Landmines are cheap to make, long-lasting and time-consuming to find and make safe, so they are a uniquely dangerous legacy of conflict.

At least 4710 people were injured or killed by landmines and other abandoned explosives in 2022, with civilians making up 85 per cent of that figure, half of whom were children.

Martin Jebens at the International Committee of the Red Cross and his colleagues have created an AI tool they call DeskAId that can use satellite images to pinpoint the likely locations of landmines based on knowledge of where they have been found in previous conflicts, as well as the locations of roads, buildings and medical facilities. The AI learns patterns in the placement of mines in relation to these sites, which it uses to predict where they may have been laid when shown maps of new areas.

The system is being tested in Cambodia and the researchers are in talks to trial it in other regions (arXiv, doi.org/mxq7).

Those behind the project didn't respond to a request for comment, but Andro Mathewson at The HALO Trust, a non-governmental organisation that works on landmine clearance, says AI has the potential to bolster removal efforts, although the final step will always involve workers on the ground.

"Landmines are the hidden killer. You don't know where they've been placed"

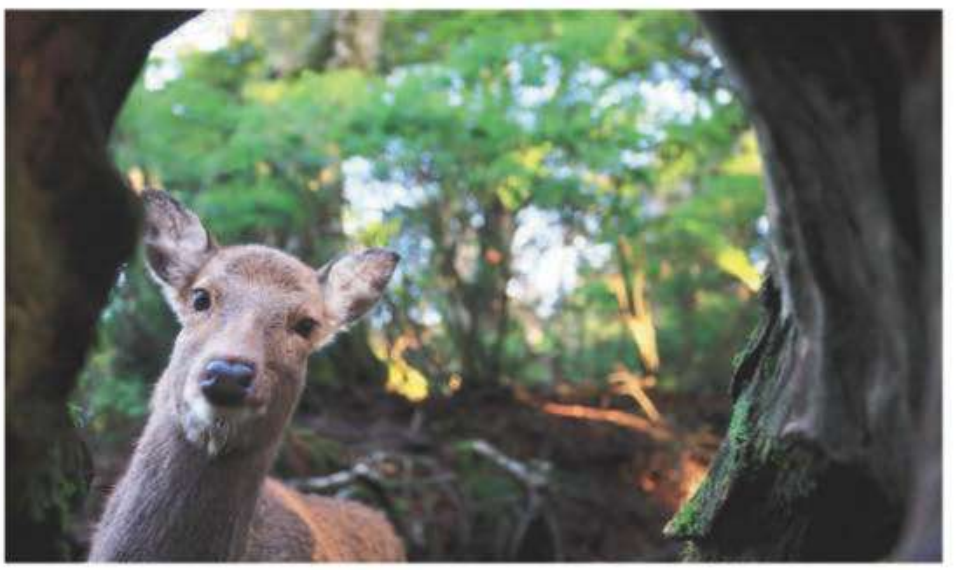
"There is massive, massive potential for efficiencies: time-saving, money-saving and, ultimately, hopefully, life-saving," he says. "[Landmines are] the hidden killer. You don't know where they've been placed. Some accidents can be as simple as a family in their car driving over an unpaved road, and that road was mined a few years ago. It's a landmine that's invented to take out a 20-tonne tank – you can imagine what it does to a personal vehicle."

Mathewson says clearing landmines starts with accumulating data, which could be military information on mine locations, rough maps made by people who were present when they were laid or verbal interviews with locals, as well as data on where and when accidents have occurred.

Sometimes this information can be decades old, as in The HALO Trust's current work in Cambodia, which is reliant on declassified spy satellite imagery taken by the US in the 1980s. ▮

Evolution

Hungry deer may have driven plants to become tinier



CYRIL RUOSO/MINDEN PICTURES/ALAMY

Thousands of sika deer live on Yakushima Island in Japan

DOZENS of plants on a small Japanese island may have evolved to be smaller, in order to avoid hungry deer.

Miniaturised plants are found all over the world, says Daiki Takahashi at Tohoku University in Japan, but they are usually a reaction to environmental factors such as cold, dry or windy conditions.

The alpine reaches of Yakushima Island in Japan host more than 80 plant species that are a fraction the size of their close relatives on the larger Japanese islands.

To investigate why this might be, in 2017, Takahashi and his colleagues visited Yakushima Island and noticed tiny plants next to standard-sized species that are unpalatable to deer. The island hosts between 12,000 and 16,000 Japanese sika deer (*Cervus nippon yakushimae*). Yakushima Island's deer density is five to 10 times higher than it is on Japan's mainland and other islands, due to a lack of local predators, says Takahashi.

The team measured the dimensions of 40 pairs of closely related mountain plant species, each containing samples from Yakushima Island and from the mainland. Of the 40, 33 pairs differed greatly in size, with some Yakushima plants reaching just one-tenth the size of their mainland counterparts. Of these pairs, 28 are appetising to deer.

The researchers analysed differences in precipitation, sunlight and nutrient levels between the island and mainland, but found that none could account for the tiny plants. They suggest it is the appetite of the island deer that drove the plants' evolution into dwarves.

Grazing has previously been linked to dwarf plant evolving, but Takahashi and his colleagues argue they have offered the first evidence of herbivores pushing many plant species to independently do this (*Journal of Ecology*, doi.org/mxqk).

The researchers analysed the plants' DNA to reconstruct their evolutionary history and found that the dwarf plants evolved over tens of thousands of years, possibly from sustained pressure from deer.

These findings show the strength of evolution to shape whole suites of organisms along the same evolutionary pathways, says Kevin Burns at Victoria University of Wellington in New Zealand. ▮

Jake Buehler

Physics

The quantum arrow of time

A new way to think about why time only flows in one direction has major implications for both the universe's early period and its eventual demise, says **Leah Crane**

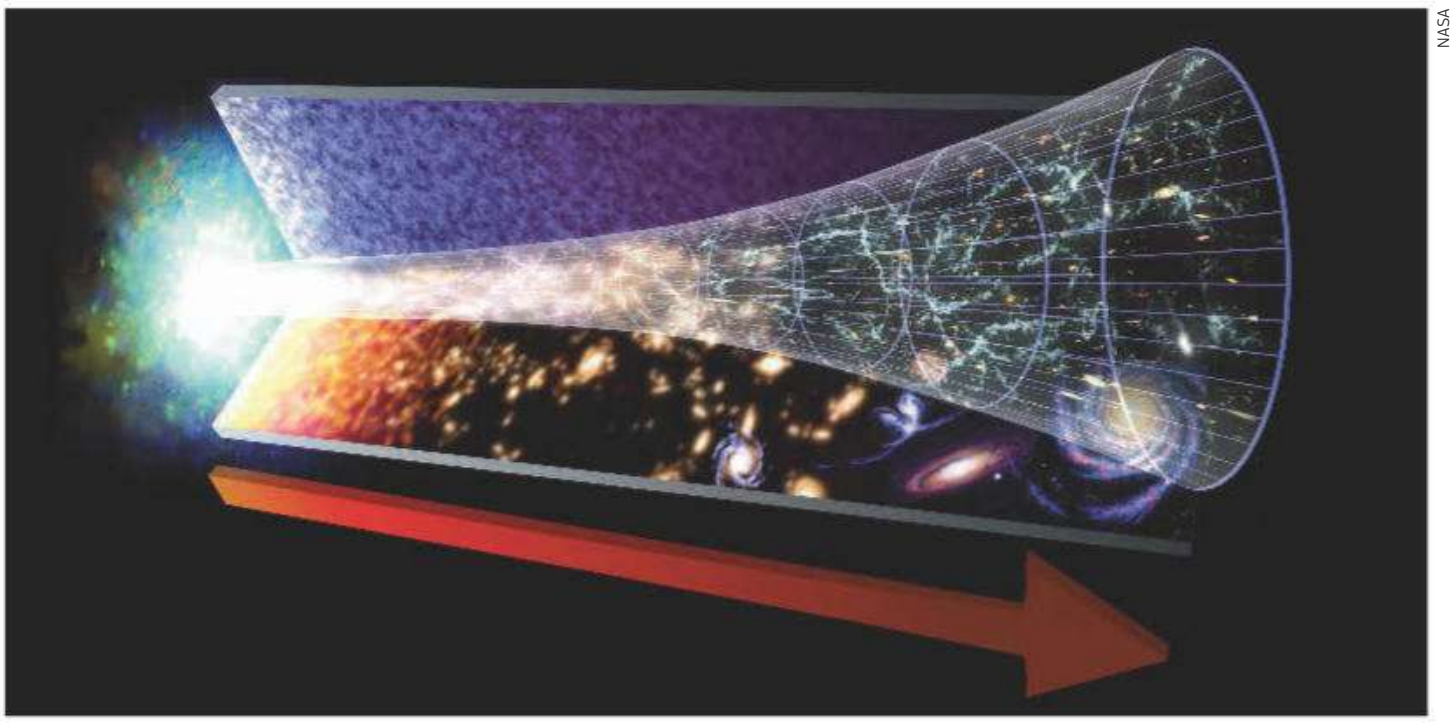
IN THE beginning, there was no quantum entanglement. That is the conclusion of a study exploring the so-called entanglement past hypothesis, which is part of a quantum reinvention of our notions about why time only flows in one direction.

When two particles become entangled, each can no longer be thought of as an independent object – their properties are tied together, even if they are physically far apart. However, unless these particles are perfectly isolated from the environment, outside interference will eventually cause their entanglement to break down in a process called decoherence.

This phenomenon inspired an idea called the decoherent, or quantum, arrow of time. This posits that because decoherence is irreversible, it could be the fundamental reason why time flows forwards and never backwards. This is related to the more traditional thermodynamic arrow of time, where the direction of time's flow is governed by the idea that entropy, or disorder, must always increase – a concept at the core of the second law of thermodynamics.

If you follow the thermodynamic arrow back to the beginning of time and reconstruct the starting state of the universe – known as the thermodynamic past hypothesis – you will conclude it must have been one of extremely low entropy. Jim Al-Khalili at the University of Surrey in the UK and Eddy Keming Chen at the University of California, San Diego, have now performed a similar analysis to define the entanglement past hypothesis.

Their research suggests that there was no quantum entanglement in the earliest moments of the universe. As the cosmos evolved, there was more and more entanglement and, correspondingly, more and more decoherence (arxiv, doi.org/mx7z).



NASA

The "arrow of time" could tell us what the early universe was like

"People have been vaguely aware that you need some kind of past hypothesis to get the decoherent arrow of time, but it hasn't really been worked out in detail before," says Emily Adlam at Chapman University in California. "This clarifies what exactly that beginning state of the universe is."

While we cannot directly observe the beginning state of the universe and it may not seem relevant to the current state of things, it is crucial to our understanding of how things have evolved since then – and even what "since then" really means.

"Once you get beyond that very early universe, you have thermodynamic entropy, you have gravity clumping everything up, so you move away from concerns about quantum entanglement," says Al-Khalili. "Once you have an arrow, once you have a direction to time, everything else happens on its own – we just needed the starting point."

Al-Khalili and Chen also found that a low-entanglement initial state would have low thermodynamic entropy, which hints that the thermodynamic and quantum arrows of time may be connected to one another.

Moreover, the decoherent arrow might be more useful for understanding the behaviour of the universe. "For the thermodynamic arrow of time, you're sort of zooming out," says Al-Khalili, meaning there is a degree of subjectivity in measuring its precise properties. "The decoherent arrow of time is a bit more objective," he says. This suggests that it is more of a fundamental law of the universe.

"This means that there are actually interesting things that happen after the heat death of the universe"

"The hope is that you derive the thermodynamic past hypothesis from the entanglement past hypothesis, and then they become different aspects of one another," says Adlam. That would give us a more complete understanding of the nature of time.

All this could mean that the end of the universe isn't as simple as we thought. The general consensus is that the universe is most likely to end in a state called heat death, in which all energy is evenly distributed throughout space and nothing ever changes. But the decoherent arrow of time suggests the cosmos will continue to evolve even after this point.

"It will take many, many billions of years later to reach maximum entanglement," says Chen. "This means that there are actually interesting things that happen after the heat death of the universe."

If the entanglement past hypothesis is true, it could set in stone the very existence of time, says Al-Khalili. "The flow of time, one can quite easily argue that that is subjective, but the direction of time, I would argue, is fundamental, and therefore time is real," he says. ▮

Analysis Mental health

Could anxiety or depression be 'transmitted' between classmates?

Having one person in a school class with a mental health condition has been linked to a higher risk of such a diagnosis in their peers. But are these illnesses contagious, asks **Clare Wilson**

IF THERE is one thing most people know about teenagers and their mental health, it is that things are getting worse. Rates of several mental health conditions are on the rise in this group, especially in the US, but also in Australia, the UK and many other European countries.

Many possible causes have been debated, but now further evidence has emerged for a possibility that has long been suspected, but has been hard to quantify: that mental health problems can, in a way, be transmitted between friends.

If this is right, it would mean our approaches to helping troubled teens with conditions such as depression need re-examining. Some methods may even make things worse. So, how strong is the evidence?

There is no shortage of explanations proposed for young people's worsening mental health. They include the explosion of social media use, as well as longer-term societal changes, such as growing pressure to do well at school or changing parenting styles that may leave children less resilient.

The transmission idea doesn't imply that mental health conditions are literally contagious, caused by bacteria or viruses (see page 17 for more on this). It proposes that when teens see friends develop such a condition, it becomes more likely that they follow them down the same route, says Christian Hakulinen at the University of Helsinki in Finland.

It has long been known that some conditions, such as eating disorders, can spread through friends. More recently, they have been shown to spread through online networks too. Previous studies have also found that anxiety and depression can cluster among groups of friends. But this could be because someone who is prone to anxiety, for example, may be drawn to other anxious people.

To tease out what is happening, Hakulinen and his colleagues tracked the school and health records of more than 700,000 people – all Finnish children who turned 16 between 2001 and 2013 – to see if correlations also happened within school classes, because pupils can't choose their classmates.

Sure enough, over the first year, if one person in a class had any mental health condition, there was a 9 per cent higher chance that their classmates would also get one. Those with more than one affected classmate had an 18 per cent higher risk of being diagnosed themselves.

"It has long been known that some conditions, such as eating disorders, can spread through friends"

The effects were stronger when considering specific conditions: in other words, if one pupil had anxiety, others were more likely to develop anxiety. This was true for depression and eating disorders too.

As the researchers checked in with the teens, for an average of 11 years, the effects remained but got smaller if someone had more than one affected classmate and disappeared if they had just one affected classmate (*JAMA Psychiatry*, doi.org/mxh3).

An important caveat is that this study can only show correlations, not causation. Something else could be causing all children in a class to be at risk of worse mental well-being. The researchers did adjust their figures to take account of factors known to affect mental health, however, such as an area's income level and employment rate.

But the study didn't adjust for factors that could be worsening everyone's mental health within a class, such as having a bully present or a poor teacher. Yet that seems less likely because the effects were seen for several years after the children turned 16, says Jack Andrews at the University of Oxford.

If transmission is real, it could be happening in several ways. For instance, a phenomenon in psychology is "co-rumination", where two friends who have depression or anxiety tend to talk excessively about negative experiences, leading to both their moods spiralling downwards.

There may also be unconscious effects at work. Teens who hear about mental health problems through their friends may be more likely to interpret everyday stress or distress in a medical light.

Some people may also be envious of the attention affected classmates are getting, so exaggerate any similar symptoms themselves.

On the other hand, this could also lead people to seek needed support earlier, says team member Jussi Alho, also at the University of Helsinki. "This kind of normalisation of treatment and diagnosis could be considered a beneficial transmission of mental disorders."

If mental health conditions really are socially contagious, it suggests ways of prevention. For instance, if a person in a class develops an eating disorder, adults may want to be more alert to similar signs in classmates. Alternatively, when classes are allocated, schools may consider putting someone who is thought to be at risk in with people who seem more resilient, says Andrews.

It also suggests that education campaigns about mental health should explain the difference between everyday distress and a clinical condition. "We have to be careful that we don't overtreat and think that normal reactions are somehow abnormal behaviour," says Hakulinen.

Andrews, along with his Oxford colleague Lucy Foulkes, has proposed the "prevalence inflation hypothesis" about mental health conditions, which says rates are rising partly because well-intended awareness campaigns contribute to this kind of medicalisation of life's normal ups and downs.

The idea that mental ill health can spread may make some people feel uncomfortable, and the latest study is by no means clinching proof of it, says Andrews. Yet the findings may help us understand the mechanisms behind the youth mental health epidemic and combat them. ▮

MASKOT/GETTY IMAGES

People with mental health conditions are often advised to talk about them

Archaeology

How early humans reached Australia

Excavations on the island of Timor hint at which route was used to first settle vast continent

James Woodford

A CAVE on the island of Timor has given us a vital clue to the route taken by ancient humans when they first made their way to the Australian continent.

It is known from archaeological evidence in Australia's Northern Territory that people were there at least 65,000 years ago. At that time, when sea levels were lower, Australia and the island of New Guinea were part of a larger landmass known as Sahul.

Researchers believe there are two likely routes people could have taken from South-East Asia to Sahul. One is a southern route via Timor. Or, *Homo sapiens* could have travelled via Sulawesi, an island to the north of Timor.

Now, Sue O'Connor at the Australian National University in Canberra and her colleagues believe they have found evidence ruling out the possibility that the first arrivals came through Timor.

In other locations on this island, the oldest evidence of human occupation was less than 50,000 years old. Archaeologists were unable to look for older artefacts because, at all the other sites

MIKE MORLEY

Sediment layers in Laili cave in East Timor are key to dating ancient migration

there, they hit bedrock rather than sediment layers that could potentially contain evidence of an earlier presence, says O'Connor.

In 2019, her team dug a new pit at a cave called Laili – on the north coast of Timor in the country of East Timor – and discovered a rich deposit of evidence including tens of thousands of stone tools, showing that humans had occupied the island for 44,000 years.

Crucially, this layer of occupation was underlain by sediments with no evidence of humans (*Nature Communications*, doi.org/mxh4). This means it is likely that before 44,000 years ago, people were absent, says O'Connor. She says such a clear boundary between no evidence of humans followed by tens of thousands of years of artefacts is called an "arrival signature".

The big cave's prominent location near the coast and access to resources gives the researchers confidence that it is unlikely to have been missed by early travellers. "It's a perfect place for people to establish an occupation base camp. You couldn't find a more ideal setting," says O'Connor

Because of the evidence that

"This cave is a perfect place for people to establish a camp. You couldn't find a more ideal setting"

people were in Australia 65,000 years ago but not in Timor until 44,000 years ago, it means humans probably migrated via the islands to the north, says O'Connor.

Peter Veth at the University of Western Australia says the case for a later date for Timor's occupation is building, adding that ancient Australians weren't as isolated as once thought and several waves of migration to Sahul were likely.

"I think an earlier northern route seems plausible. This is a highly significant site as, based on a broad suite of shellfish, fish, Crustacea and other resources found in the cave, it shows there was a fully fledged maritime economy in place when Timor was settled," he says.

Zoology

Ants learn faster if they get a hit of caffeine

A SHOT of caffeine isn't just a brain booster for people. Ants that drink a caffeinated solution can locate sweet rewards faster, suggesting the drug boosts learning.

To see how Argentine ants (*Linepithema humile*) respond to caffeine, Henrique Galante at the University of Regensburg in Germany and her colleagues placed a drop of sugary solution on a piece of paper. Some solutions contained no caffeine, while others had low, moderate or high amounts.

Individual ants were set onto the paper to find the sweet treat. Once they had found and drunk from the solution, the trial was repeated, with the ant again set to find a drop in the same location. Each of the 142 ants in the study did this four times in a row.

"We took a bunch of measures of their paths and how fast they were at finding the food source to assess if caffeine is actually improving their learning," says Galante.

Ants that received low or moderate doses of caffeine took a

SHUTTERSTOCK/TOMPEL

A morning blob of coffee could help ants get things done more efficiently

more direct path to the sweet treat with each attempt, suggesting they had remembered the location of the reward. Ants without caffeine took more meandering paths that didn't improve over time. The caffeine didn't make the ants move faster, says Galante, but more efficiently: it reduced their twists and turns.

More caffeine isn't always better, though. Ants that drank the lowest dose – 25 parts per million, similar to levels found in some plants – improved their search time by 28 per cent. Ants that got the moderate 250 ppm dose – close to an energy drink – were even more adept, dropping search time by 38 per cent. But the highest dose, 2000 ppm, was fatal (*iScience*, doi.org/mxkx).

Corryn Wetzel

Astronomy

Sun's dynamo may hide just beneath the roiling surface

Leah Crane

THE sun's magnetic field may not be as deep as we thought. For decades, scientists thought the sun's dynamo – the area that generates its strong magnetic field – was located far within the star. Now, evidence hints it lurks just under the surface.

The strength of the sun's magnetic field fluctuates on an 11-year cycle. During the strongest part of the cycle, sunspots and powerful winds emerge near the solar equator, along with the plumes of material that cause the aurora borealis on Earth. Ideas for how the magnetic field is generated can't easily explain how all of those phenomena are connected, though.

The sun behaves like a giant clock, with the many eddies and flows of plasma within it acting as the gears that make it tick, says Geoffrey Vasil at the University of Edinburgh, UK. "Nobody really knows how those things fit together or even what they all are."

Vasil and his colleagues suggest that the sun's magnetic field stems from instability in the rotation of plasma inside it. Such instability may occur in the outermost 5 to 10 per cent of the sun.

The researchers modelled how this instability would churn the plasma of the sun's outer layers. They found that it could give rise to sunspots and create the powerful winds that whip around the sun during its period of maximum activity, along with other magnetic phenomena. Simulations with a dynamo close to the surface matched observed magnetic patterns on the sun better than those with a deep dynamo (*Nature*, doi.org/mxg5). "It's very satisfying to have lots of things fit into place and make a lot of sense," says Vasil.

A clearer understanding of the sun could let us better forecast solar activity that spawns stunning aurorae – and messes with electrical grids on Earth. ▮

Health

Why the way bird flu spreads between cows is still a mystery

Grace Wade

PUBLIC health experts still don't know how a bird flu virus has been spreading for months among dairy cows in the US – although early evidence points to contaminated milking equipment.

Since late March, 52 dairy herds across nine US states have tested positive for H5N1, a bird flu virus that has killed millions of birds and thousands of mammals worldwide. Genetic analysis of samples from infected cattle suggests the outbreak began when cows on a Texas farm contracted the virus from wild birds. It then spread to other herds as infected cows moved between farms. But how the virus jumps from cow to cow is unclear.

"This is a critical question that is still under investigation," said Andrew Pekosz at Johns Hopkins University in Maryland during a press briefing on 15 May. "There are most likely two ways the virus is spreading," he said.

Cow's milk being tested for bird flu at the Broad Institute in Massuchusetts

DAVID L. RYAN/THE BOSTON GLOBE VIA GETTY IMAGES

The first is respiratory transmission. Infected cows may be expelling the virus in small droplets of mucous or saliva that other cows then inhale or ingest when sharing food and water, says Seema Lakdawala at Emory University in Atlanta, Georgia.

However, infected cows show mild to no respiratory symptoms, and their nasal swabs contain low concentrations of the virus, suggesting another mode of transmission.

"I think it's the milking equipment," says Lakdawala.

Raw milk from sick cows contains high concentrations of H5N1 and can thus transmit the virus. Several cats contracted bird flu after drinking unpasteurised milk, for instance. This is why it is crucial that humans avoid raw milk products.

Although adult cows don't drink raw milk, they do share milking equipment. Dairy workers normally wash a cow's udder before hooking it up to the milker and again after removing it. But not all dairies disinfect the milking equipment between each cow, says Sid Miller at the Texas Department of Agriculture. Consequently, rubber inside the milking equipment can contain residual raw milk.

In an unpublished study, Lakdawala and her colleagues found that H5N1 in milk survives on rubber surfaces for at least an hour at concentrations high enough to be infectious. Another preliminary study from Charlotte Kristensen at the University of Copenhagen in Denmark and her colleagues shows that mammary glands from a lactating dairy cow contain multiple receptors for H5N1.

52
Number of dairy herds that have tested positive for H5N1 bird flu

"Whether there is some infection through the skin or some other route, I don't know, but that [milking equipment] definitely has contamination potential," says Lakdawala.

Miller says the Texas Department of Agriculture is recommending that dairy farmers disinfect milking equipment between each cow.

All of this evidence is far from conclusive, and poor surveillance has made it nearly impossible to pinpoint or rule out other potential pathways of transmission – which must be done if the outbreak is to be contained, says Lakdawala. To encourage dairy farmers to boost surveillance, the US Department of Agriculture (USDA) announced on 10 May that it would compensate them for lost milk production and H5N1 testing costs. ▮

Environment

Cement without the emissions

A process that uses waste from demolished buildings could cut the climate impact of construction

Madeleine Cuff

CEMENT can now be made using the waste from demolished buildings, which researchers say could save billions of tonnes of carbon by 2050.

"We have definitely proved that cement can be recycled into cement," says Julian Allwood at the University of Cambridge. "We are on course for making cement with zero emissions, which is amazing."

The production of cement is responsible for 7.5 per cent of total greenhouse gas emissions, but until now there was no known way to make it on a big scale without affecting the climate.

Creating cement requires "clinker", which is made by heating a mix of raw materials, including limestone and clay, to 1450°C. Both the heat requirements and the chemical reactions involved in making clinker result in carbon emissions, and clinker production accounts for 90 per cent of cement's total carbon footprint.

Allwood and his colleagues have now developed a way to make clinker by reusing cement paste made from demolished buildings. This paste has the same chemical composition as lime flux, a substance used to remove impurities from recycled steel.

MATERIALS PROCESSING INSTITUTE

Making cement in an electric arc furnace at the Materials Processing Institute, UK

As the steel melts, the flux made from old cement forms a slag that floats on the top of the recycled steel. Once ground into a powder, the slag is identical to clinker. It can then be used to make Portland cement, the most common form of cement.

If the recycled steel and cement are produced using an electric furnace, powered by renewable or nuclear energy, the process is almost entirely free of emissions. "The idea is really simple," says Allwood.

Lab trials have shown that the process works. It offers a "drop-in" solution that could be used with conventional equipment, and a global switch to this process could save up to 3 gigatonnes of carbon dioxide a year, it is calculated (*Nature*, doi.org/mxg7).

The team is now working on industrial tests via a spin-out company, Cambridge Electric Cement, with partners such as construction firms Balfour Beatty and Tarmac. "Within the next few weeks, we are starting a set of trials which will be producing batches of 30 tonnes per hour," says Allwood.

Scaling up the new cement-making process depends in part on the growth of recycled steel-making, which accounts for about 40 per cent of global steel production. Allwood says production rates will at least double over the next 30 years, and most likely treble, as the industry decarbonises.

Yet challenges lie ahead. The recycled cement process requires furnace temperatures of 1600 to 1750°C, slightly hotter than traditional cement production. This will increase power costs, says Leon Black at the University of Leeds, UK.

"Within the next few weeks, we are starting trials that will be producing batches of 30 tonnes per hour"

Other hurdles include creating supply chains for waste cement, attracting investors and convincing the industry to adopt a new process on a large scale.

"They have overcome one barrier in as much as they have made a material that has the same composition as Portland cement," says Black. "The devil is in the details: the energy requirements, the logistics, the scaling up." ▮

Genetics

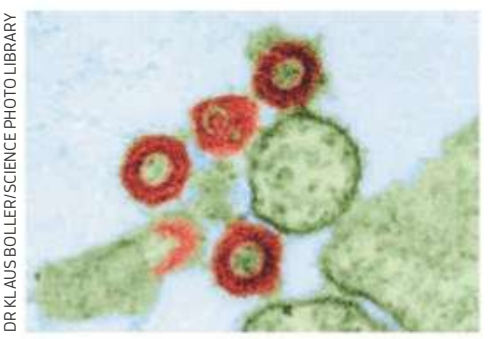
Ancient viruses linked to mental health conditions

OUR ancestors cast a very long shadow. Viruses that became embedded in human DNA millions of years ago may raise the risks of people getting depression, schizophrenia and bipolar disorder. The viral genes have unusual activity levels in people with a higher genetic risk of experiencing these mental health conditions, a study has found.

Retroviruses are viruses that insert their genetic information into the DNA of their host. Remnants of such viral genes can be seen in the DNA of many animal species, and these sequences are called human endogenous retroviruses (HERVs) when found in the human genome.

Until recently, most HERVs were thought to remain dormant and were called "fossil viruses". But studies have suggested that some of the viral genes may be active – although not producing infectious viruses – and may even play a role in neurological conditions, such as multiple sclerosis.

Now, Timothy Powell at King's College London and his colleagues have looked for these viral remnants in nearly 800 brains donated for medical research.



DR KLAUS BOLLER/SCIENCE PHOTO LIBRARY

Particles of the HERV-K retrovirus (red) budding off a human tumour cell (green)

The team didn't record if any of the donors had been diagnosed with mental health conditions while alive, but found that some genetic variants known to raise the risks of depression, schizophrenia and bipolar disorder were associated with altered activity of genes from five different HERVs (*Nature Communications*, doi.org/mxg9).

The unusual viral gene activity could raise the risk by a few per cent, if it is having an effect, says Powell. But altered HERV activity may not cause the conditions, it could be a consequence, he says.

"The results are likely real that these things are markers of these diseases, but [the researchers] are rightly cautious in saying they don't know what that means," says Rachael Tarlinton at the University of Nottingham, UK. ▮

Clare Wilson

Archaeology

Soldiers test ancient armour to show it worked for war

Jeremy Hsu

MODERN soldiers have donned replicas of ancient Greek armour and engaged in exercises inspired by Homer's epic poem the *Iliad* to see if the armour really could have been used in combat.

Andreas Flouris at the University of Thessaly in Greece and his colleagues persuaded Greece's Hellenic Marines to wear 23-kilogram replicas of Dendra armour – one of the oldest complete suits of metal armour from Europe's Bronze Age. Each participant then walked, ran, rode on a replica chariot and performed combat moves with a sword, spear, bow and arrow and even a stone.

These activities followed Homer's descriptions of the actions of heavily armoured warriors on the battlefield. "Homeric fighting activity was characterised by hit-and-run tactics, a form of physical effort described in modern physiology as 'high-intensity interval exercise'," says Flouris.

Throughout the 11-hour exercise period, the researchers recorded participants' heart rate, core body temperature and average skin temperature; tested their blood; and measured the energy cost of each activity. They also assigned an *Iliad*-inspired Mediterranean meal plan, featuring heavier breakfasts and dinners along with snacks such as dry bread, honey, goat cheese and onions.

The armour-wearing volunteers endured the trial, despite reporting fatigue and soreness. The team also used a computer model to show how a warrior wearing the armour could have lasted an 11-hour combat period in all but the most extreme weather (*PLoS One*, doi.org/mxg2).

The tests suggest that the 3500-year-old Dendra armour suit was indeed suitable for battle. Some scholars have argued that it was merely a ceremonial outfit. ▮

Earth science

Japan's earthquake swarm may have been triggered by heavy snow

James Dinneen

A SWARM of thousands of earthquakes in Japan, lasting for years, was probably triggered by environmental factors like rain, heavy snow and rising sea level.

"The changing climate can have some impact on the stress state of the Earth beneath our feet," says Qing-Yu Wang at the Massachusetts Institute of Technology.

The shaking began in Japan's Noto peninsula on the island of Honshu near the end of 2020. Since then, the area has experienced more than 100 small earthquakes per day. On the first day of 2024, the region felt a large magnitude-7.5 earthquake that destroyed tens of thousands of buildings and killed at least 240 people. But it is unclear whether that quake fits within the swarm.

Wang and her colleagues analysed seismic activity in the region between 2012 and 2023 to investigate what triggered the swarm, which ranks among the largest ever observed. These swarms commonly erupt in volcanic regions, but typically last weeks or months.

The researchers suspected that these partly stem from a rise in the pressure of fluid within porous rocks located kilometres underground.

100+

This many earthquakes have been hitting part of Japan a day

With such excess pressure, "the whole structure becomes weak", says Wang.

Fluctuating weight on the surface from sources like rain, snow, atmospheric pressure and sea level can also shift pore pressure, she says. When combined with high pressure from fluid below, it could trigger earthquake swarms.

So, the team modelled the influence of upwelling fluids and variations in surface weight on pore pressure. Snowfall seemed to have the greatest influence of all surface factors. When the researchers included snow's influence in their model, the correlation with seismic measurements improved by 10 per cent compared with a model without snow. A clear seasonal pattern in the seismic activity also supported a link between the swarm and changes in weather (*Science Advances*, doi.org/gtt6d3).

This doesn't suggest environmental factors solely caused the earthquake swarm, says Wang. She thinks they put more pressure on fractures and faults already weakened by excess pore pressure.

"These guys made a pretty good case that water is the culprit," says Stephen McNutt at the University of South Florida. But we don't know if snow often triggers earthquakes elsewhere, he says.

Snowfall and other changes in water load have been linked to "modest changes in seismicity" elsewhere in Japan, as well as in the Himalayan mountains and California, says Roland Bürgmann at the University of California, Berkeley. However, he says it is nearly impossible to conclude whether they affected any individual earthquake.

Researchers are also still working out how environmental drivers of earthquakes could be linked to human-driven climate change, says McNutt. Climate-related changes like melting glaciers, rising sea level and heavy precipitation are all possible contributors to earthquakes.

While climate change will probably have some effect on seismic activity, Bürgmann says "changes in earthquake hazard should probably be the least of our concerns when it comes to the impact of climate change". ▮

Snow seems to increase the pressure underground in Japan

SUZUKI KAKU/ALAMY

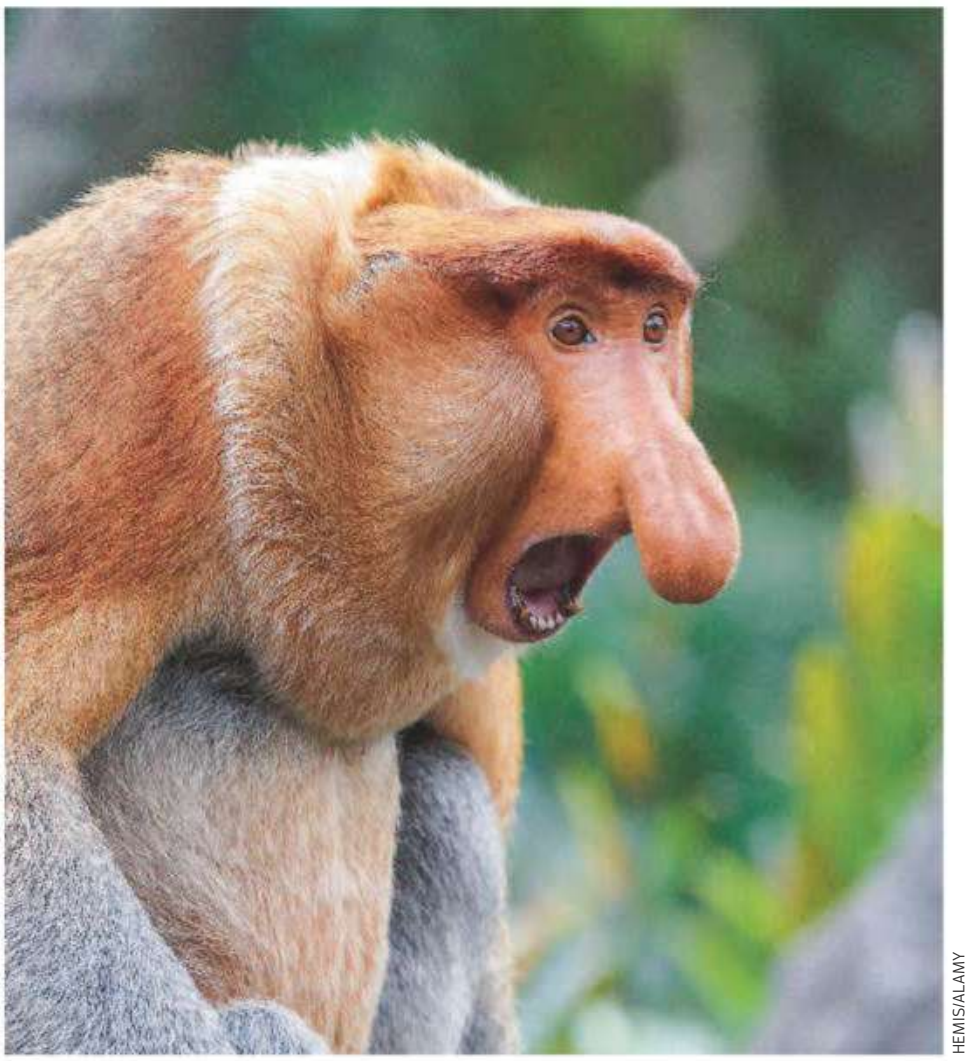
Technology

Quantum device can pick up heart signals

A DIAMOND-based quantum sensor has been used to measure magnetic signals from the heart of a living animal for the first time.

These weak signals, which can be used to diagnose cardiovascular disease, are usually measured with costly and bulky equipment. Xing Rong at the University of Science and Technology of China and his team developed a sensor based on a diamond about 100 micrometres thick in which some carbon atoms are replaced with nitrogen.

When exposed to a laser and microwaves, quantum effects involving electrons mean the glow of the diamond alters in different magnetic fields. The sensor picked up the faint heart signals of a rat (*Physical Review Applied*, in press). This could be a step towards using such tools in medical settings. **Karmela Padavic-Callaghan**



HEMIS/ALAMY

Animal behaviour

Cattle prefer the touch of a woman

THE animals used in "cow cuddling" schemes to reduce our stress and loneliness prefer interacting with women than with men, a small study suggests.

Katherine Compitus at New York University and Sonya Bierbower at the United States Military Academy West Point invited five women, five men and one girl to meet two castrated male Holsteins. The volunteers took brushes and treats and interacted with the steers.

The women and girl reported more incidences of the steers licking, accepting food and responding to efforts to train them, but also put in more effort themselves (*Human-Animal Interactions*, doi.org/mxhb). "For some reason, the women seem to enjoy it more – and the cows enjoyed it more too," says Compitus. **Christa Lesté-Lasserre**

Zoology

Huge nose key to success of male proboscis monkeys

THE bizarre enlarged nose of male proboscis monkeys acts like a trumpet, enabling them to make loud sounds that attract females and intimidate rivals.

"No other monkeys have a big nose like that," says Katharine Balolia at the Australian National University in Canberra. "That nose has become a signal of health and dominance," she says, but how exactly was unknown.

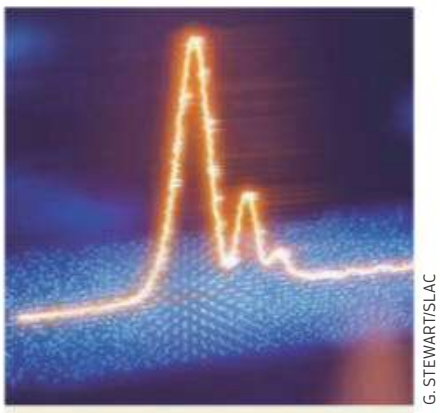
To find out more, Balolia and her colleagues analysed the anatomy of proboscis monkeys (*Nasalis larvatus*) and compared their nasal structure with those of blue monkeys, king colobus monkeys and crab-eating macaques. The nasal aperture in male proboscis monkeys was 29 per cent larger than in females. For the other three species, the difference between sexes was between 7 and 15 per cent.

Male proboscis monkeys also had a 26 per cent larger nasal cavity than females, compared with a 7 to 17 per cent difference in the other three primates. The nose only reaches its full size once males become sexually mature and establish groups with multiple females, providing evidence it is crucial to mating success (*Scientific Reports*, doi.org/mxh7).

The large nasal cavity also works like an echo chamber, says Balolia. "They use the nasal cavity to build up the sound and resonance and then straighten the soft tissue and use their nose like a trumpet."

The team thinks the large noses evolved because of the dense forest the monkeys live in, where making loud calls is important. Females might have started to select mates with large noses because it was an indication of their health, says Balolia. James Woodford

Really brief



G. STEWART/SLAC

The most powerful X-ray pulse ever

The strongest burst of X-rays ever reported has been produced at the SLAC National Accelerator Laboratory in California. In just 440 billionths of a billionth of a second, it packed nearly a terawatt of power, many times more than the average output of a nuclear power plant (*Nature Photonics*, doi.org/mxh8).

Promethium's properties probed

A new compound that contains one of the world's rarest elements, promethium, has been made. It reveals that the bond length it forms with oxygen atoms is about a quarter of a nanometre. The work may help us design new compounds for cancer treatment (*Nature*, doi.org/mxjh).

Missing fungus resurfaces in Chile

A small mushroom native to Chile's mountains has been found again, more than 40 years since its only recorded sighting in 1982. The big puma fungus (*Austroomphaliaster nahuelbutensis*), which is grey-brown with a hint of red, stands around 4 to 5 centimetres tall.

Survey

NewScientist

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Could weight-loss drugs help head off climate disaster? p31

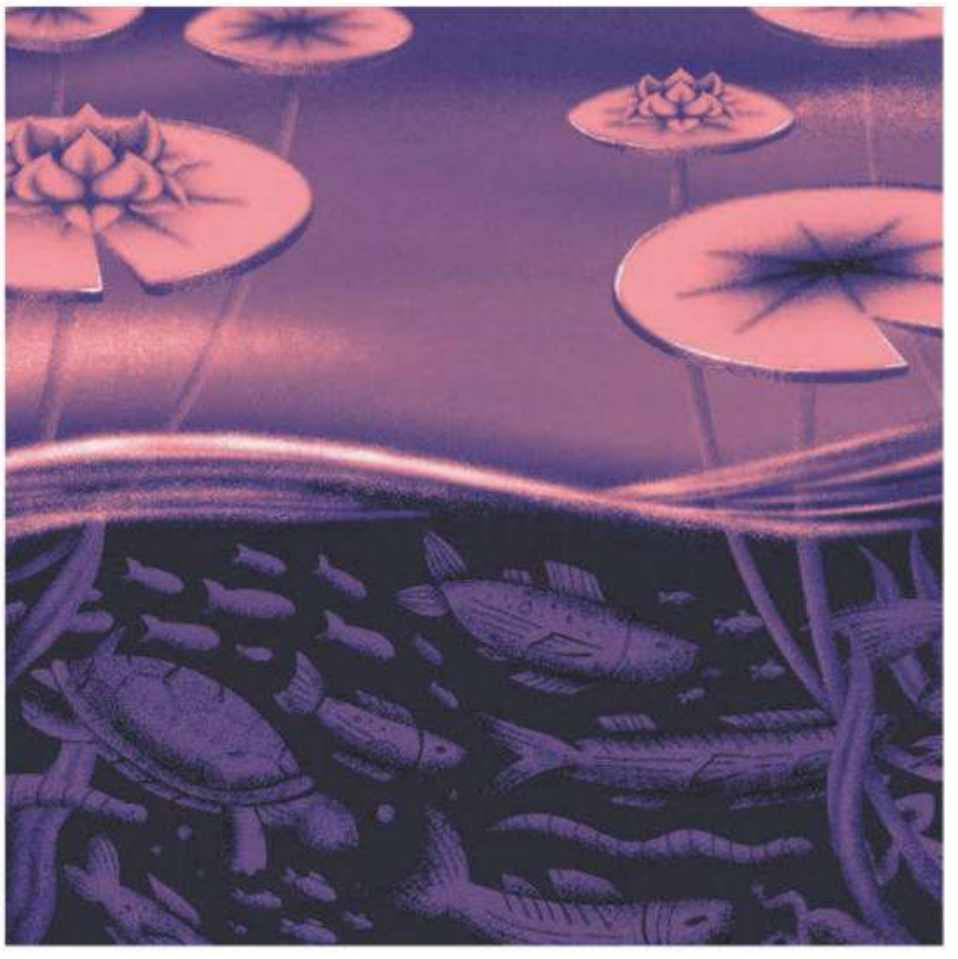
Comment

Our forgotten oases

Ponds have long been neglected by science, but we can't afford to ignore these nature hotspots any more, say **Jeremy Biggs** and **Penny Williams**

CONSIDERING they are the world's most numerous patches of water, it is surprising that ponds are poorly understood. There are millions – possibly billions – of them. Yet for a century or so, scientists have paid them very little attention.

This neglect might not have mattered were it not for increasing evidence that ponds are extremely important habitats for wildlife. Across many landscapes, they are being shown to support more freshwater plant and animal species than rivers or lakes. From microscopic algae to water beetles, aquatic plants, amphibians and water birds, ponds have rich, diverse and distinctive communities with a disproportionate number of rare and endangered species.



ELAINE KNOX

Intriguingly, this biodiversity seems to be partly due to the small size of ponds, which allows them to have a wide range of conditions. The community in a shaded pond with clear, tannin-rich water will be very different to that in a nearby seasonal pond made cloudy by grazing animals. Ponds show far greater variation than rivers and streams, as flowing water tends to homogenise water chemistry.

So why have we overlooked such a vital part of the natural world? A key reason appears to be what freshwater scientist John Downing has called "a saliency error": the cognitive bias we humans have where we tacitly assume that if something is small, it can't be all that important. Rather than study ponds, biologists in the past typically headed for the largest lake or river they could find.

Most of us also devalue ponds because we assume they are artificial habitats: we look at the human-made examples around us and don't realise that these waters have a deeply ancient origin. In our new book *Ponds, Pools and Puddles*, we debunk this idea. Ponds have clearly existed on Earth as long as there has been land and water and the geological record shows they have been a constant presence. The best-preserved evidence of pond-like freshwater communities anywhere in the world is in the Rhynie chert rocks in Scotland, which has traces of Devonian fairy shrimps swimming among stonewort plants 400 million years ago, just as they do today.

The neglect of ponds within freshwater science has had a big impact on our ability to protect their wildlife. It has created a world view in which policy-makers can simply ignore the vast networks of ponds that make up so much of the global water environment. In Europe, for example, the Water Framework Directive – the main legislation to protect freshwater features – mostly excludes any bodies of water smaller than 50 hectares (about 120 acres).

Fortunately, perceptions are changing. Last year, the Ramsar Convention, an international treaty, introduced a resolution on small wetlands, including ponds, giving crucial recognition to them. And the European Union-funded PONDERFUL project is gathering data on Europe's ponds.

There remains much to do, however, particularly if we want to harness the biodiversity power that such environments offer. As the effects of climate change deepen, plants and animals will increasingly need to move across the landscape to survive. Our work at Freshwater Habitats Trust in the UK has added to growing evidence of the importance of ponds for biodiversity. They are one of the few habitats that we can create in considerable numbers to help freshwater species adapt over short timescales. They are easy to make and they colonise rapidly.

In a world where fresh water faces big challenges, creating and protecting ponds provides a ray of hope: a piece of natural ecological engineering we can easily achieve to help support one of the most threatened bits of the biosphere. ▮

Jeremy Biggs and Penny Williams are at Freshwater Habitats Trust, a UK conservation charity

Field notes from space-time

Cosmic conundrums Discovering how weird black holes are made me want to be a physicist. There is still so much to learn about these strange regions, says Chanda Prescod-Weinstein

Chanda Prescod-Weinstein is an associate professor of physics and astronomy, and a core faculty member in women's studies at the University of New Hampshire. Her most recent book is *The Disordered Cosmos: A journey into dark matter, spacetime, and dreams deferred*

Chanda's week

What I'm reading
Arguing for a Better World: How philosophy can help us fight for social justice *by Arianne Shahvisi. It is so smart and thoughtful.*

What I'm watching
I recently saw the film Farewell My Concubine *for the first time, and wow!*

What I'm working on
Trying to understand quantum mechanics. Again.

This column appears monthly. Up next week: Graham Lawton

IT IS easy to be led astray by the mystery of black holes. As a young person, listening to Stephen Hawking describe what we didn't understand about them was what convinced me that I needed to become a theoretical physicist. They are so strange. They have this thing called an event horizon and when you cross it, the properties of space and time seem to reverse. Time might lose all meaning. Space becomes one way, in a sense, since the event horizon is a hard boundary that you can only cross once.

Black holes are unlike anything else in the known universe: points of no return embedded into the very structure of space-time. Plus, they are so massive, but also quite compact. A black hole that has the same mass as the sun would stretch only about 3 kilometres across. There are high streets that would longer than a stellar-mass black hole.

However, even discussing a black hole in terms of mass raises questions because it isn't really a material object in the same way the sun is. Rather, it is a shape-shifted piece of space-time that has intense gravitational power, pulling on things as if it were an object made of matter.

A black hole is a region, a place in space-time. It can possibly be produced through the presence of a high density of matter, which would be packed together so tightly that space-time folds in on itself, creating a phenomenon that isn't actually a hole, but isn't really a material object either.

On some level, I am speaking in terms of conjecture. No human has ever been inside a black hole. And had someone been inside, there is a decent chance they wouldn't be back again. That said, some things seem able to emerge from one. Quantum mechanics tells us that perhaps information can leak out of black holes. This idea, known as Hawking radiation, is part of what made him a big name in physics before becoming a global celebrity.

So black holes present us with an interesting conundrum: we can draw conclusions about them using calculations, but they are actually quite hard to investigate.

Hawking radiation, for example, is a phenomenon where particle pairs that are created as a result of random fluctuations get separated by the event horizon. Usually these pairs of particles, one of matter and one of antimatter,

"What's really happening in the singularity at the centre of a black hole? Our equations break down here"

would quickly annihilate each other, but the event horizon can act as a barrier that permanently separates them.

The problem? Hawking radiation won't happen at rates high enough for us to detect the particles directly and distinguish them from the other busy stuff that is happening in the universe, such as hot gases orbiting the exterior of a black hole.

Those gases themselves create all kinds of interesting effects. Not only do they radiate powerfully across the electromagnetic spectrum, but we also see interesting structures like jets of particles moving close to the speed of light that seem to shoot out from either side of a black hole. These jets are themselves a mystery because we don't fully understand what causes them to start and why only some galaxies with highly active black holes at their cores have them. They radiate strongly in radio waves and also X-rays, which gives us some indication of their inner workings, but the mysteries still abound.

For example, the galaxy M87, with a supermassive black hole at its heart, not only has jets, but the jets have a unique structure, with bright spots known as knots distributed across them. A team led by Rameshan Thimmappa, a research fellow in Joey Neilsen's group at Villanova University in Pennsylvania, has been exploring the nature of these knots through careful observations using the Chandra X-ray Observatory. This space telescope, which is sadly being defunded by the US government, allows teams like Thimmappa's to look at 20 years of data on the knots, providing insights that help us understand their fundamental nature.

In a recent paper that has been accepted by *The Astrophysical Journal*, his team found that variations in brightness of one of the knots corresponded to its distance from the core of the galaxy. This piece of information allowed the team to deduce exactly how fast the particles in the jet appear to be travelling, and make more informed guesses about what the internal shape of the jet might be.

Black holes, in the end, are more than the parts that we can't see – at least to us scientists. Of course, as a theoretical physicist, I also love the mystery of black holes from a mathematical perspective. What is really happening in the spot that we call a singularity at the centre of a black hole? Our equations break down here. But part of doing physics is about connecting with the cosmos as we witness it. And it turns out that even though we can't see black holes, they offer up a quite glorious vision. ▮

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New Scientist video
Auk eggs and mummified falcons: Inside NHM's bird archive **https://youtu.be/oNESQvUbi4o**

Amazing avians

Birds: Brilliant and Bizarre
Natural History Museum, London

WHY were birds the only dinosaurs to survive the fateful asteroid that hit Earth 65 million years ago? A new exhibition sheds light on the extent of birds' adaptability and the behaviours that allowed them to thrive in all niches.

Birds: Brilliant and Bizarre, created by the UK's Natural History Museum with the Royal Society for the Protection of Birds, pays tribute to the qualities of what it calls "ultimate survivors". But it also shows how global challenges threaten that status.

In the main image, conservators prep a great bustard (*Otis tarda*) – one of the heaviest flying birds – for the exhibition. Once a familiar sight in the UK, the species is now classified as vulnerable.

Below, the small image shows a Philippine eagle (*Pithecophaga jefferyi*), among the world's largest eagles. There are only a few hundred pairs left, writes Joanne Cooper, a senior curator at the museum and author of a book that accompanies the show. The birds are scattered across four islands in the Philippines, and with deforestation encroaching, they are classed as endangered.

The exhibition runs at the Natural History Museum in London until 5 January 2025. The book is on sale at its shop.

Gege Li

NewScientist

Emerging Technologies Summit

Hundreds of business executives and thought leaders met at an event hosted by *New Scientist* in London to discuss how the latest innovations will affect their industries

Some of the brightest and best minds from the bleeding edge of technological innovation, from fields as varied as quantum computing, artificial intelligence and the space industry, spoke to a packed crowd of scientists, business leaders and policy-makers at *New Scientist*'s Emerging Technologies Summit in London last month.

Stephen Cave, who leads the University of Cambridge's Future of Intelligence institute, made clear the importance of such an event, during the first fireside chat of the day: "Technological transformation of this profundity and rapidity needs to be dealt with at all of these levels – there is a role for us to play as individuals, as consumers, as users and as corporations, thinking through the impact of the technology we're making."

This impact includes many upsides, such as how artificial intelligence is set to transform numerous industries. Hebe Middlemiss at AstraZeneca showed how the pharmaceutical company was using generative AI to help speed up drug design and testing, and shrink drug development timelines from years to months or days. In a discussion on how AI is also set to change the creative industries, Elliott Millard at media consultancy agency Wavemaker UK revealed how ad agencies are already widely incorporating AI tools into their workflows.

These upsides are present not just in businesses, but at a wider scale too. Peter Knight, who helps lead the UK's quantum strategy, mapped out in detail how the billions of pounds in recent government investment has led to groundbreaking research and commercial interest in the UK's quantum ecosystem. One example of this commercial buy-in is with banks, demonstrated by Philip Intallura at HSBC, who spoke about how the bank is using quantum key distribution, an ultra-secure communication method impervious to the decrypting power of quantum computers, to secure financial information that it sends between data centres.

The audience also heard from the world of policy and government, with Chi Onwurah, shadow minister of science, research and innovation, reiterating how important these emerging technologies were for Labour leader Keir Starmer's plan to boost the UK's economic growth to the highest in the G7.

One of the more intriguing insights of the day was a look behind the curtain of the UK government's mysterious skunk works, the Advanced Research and Invention Agency (ARIA). *New Scientist* editor Catherine de Lange quizzed ARIA CEO Ilan Gur about what the agency was up to and what success might look like, given the world-changing technologies that came out of the US organisation it was modelled on, DARPA. "We are not thinking about how do we succeed," said Gur. "What keeps us up at night is that we may have not pushed hard enough, so that if we did succeed it actually doesn't change the world."

It was also clear from the day's talks that this moment of rapid technological change calls for a careful accounting of the whole picture, including the risks. "The benefits and opportunities by far outstrip these risks, but we need to have some serious conversations about managing and mitigating the risk of all of this technology," said de Lange. "How do we ensure ethical and responsible adoption? I hope that for many of us those conversations will start here today."

Right: Film-maker Torsten Hoffman; Far right: *New Scientist* editor Catherine de Lange

Right: Alex Wilkins (*New Scientist*) hosts a panel on the future of work with (from left) Will Venters (LSE), Nicola Millard (BT) and Linda Vernon (NHS)

Below, clockwise from top left: Shadow science minister Chi Onwurah, Hebe Middlemiss (AstraZeneca), Stephen Cave (University of Cambridge) and Philip Intallura (HSBC)

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Facing up to our AI future

To understand the power – and limitations – of artificial intelligence, we need information, not hype. **Alex Wilkins** explores what four new books offer

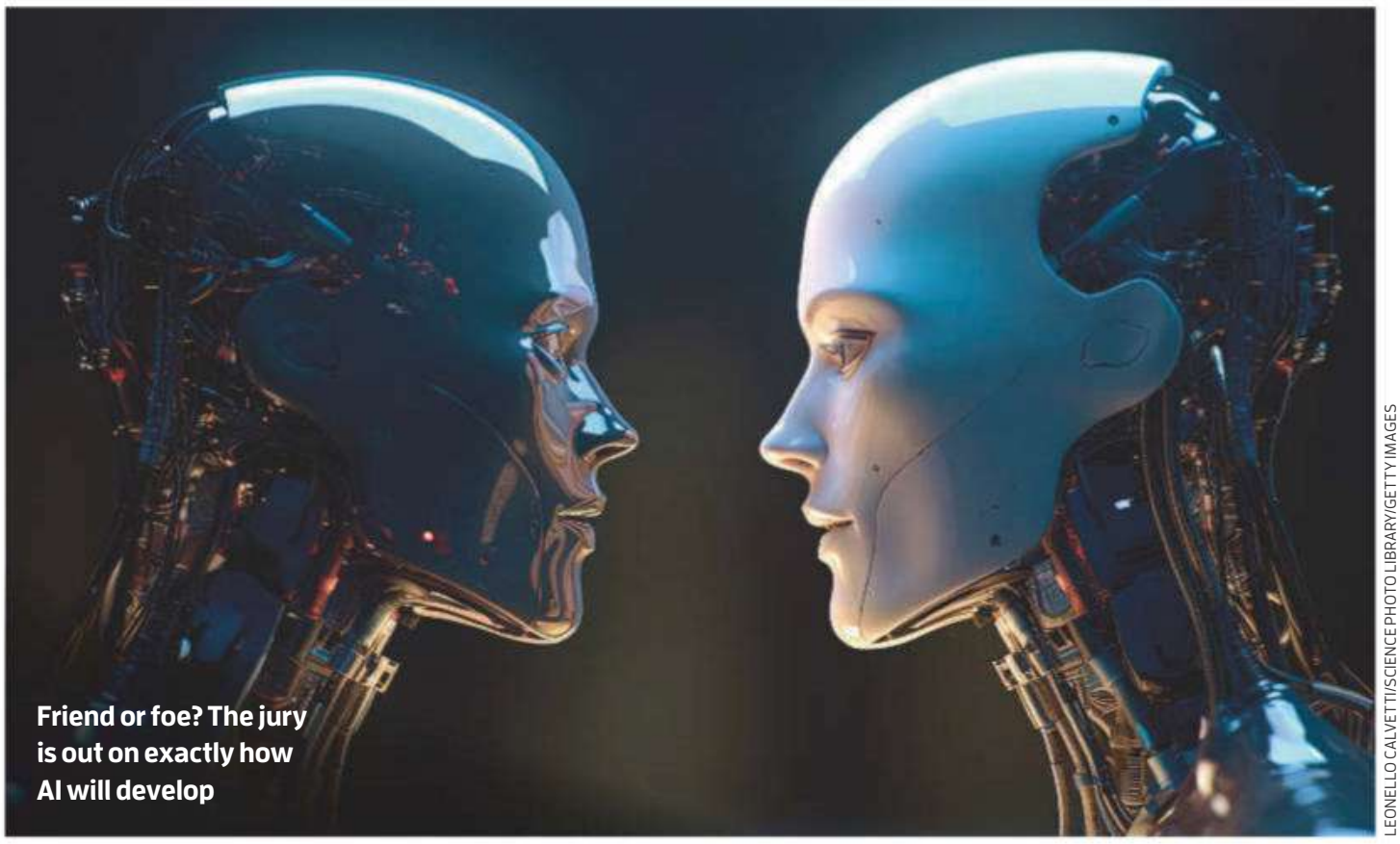
Books

Deep Utopia
Nick Bostrom
IdeaPress Publishing (on sale now)

The Singularity is Nearer
Ray Kurzweil
Bodley Head (US, 25 June)
(UK, 27 June)

The Atomic Human
Neil Lawrence
Allen Lane (UK, 6 June)
PublicAffairs (US, 3 September)

The AI Mirror
Shannon Vallor
Oxford University Press (3 June)



Friend or foe? The jury is out on exactly how AI will develop

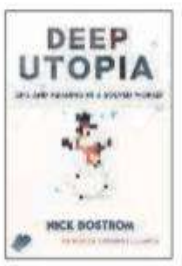
LEONELLO CALVETTI/SCIENCE PHOTO LIBRARY/GETTY IMAGES

THE success of large language models like ChatGPT as part of the development of artificial intelligence has left the future looking even more uncertain than cliché normally paints it, adding fresh urgency to old questions. Are we set for a utopian future of abundance, or might we be facing a world in which we eventually fuse with machines? Could there be dark times ahead, where we worship false gods that reflect our worst biases back to us, or will these strange tools help us better define our own nature?

A tranche of new books may help navigate these waters. Let's start with philosopher Nick Bostrom, who became well-known in AI circles for *Superintelligence*, his 2014 book in which he conjured the idea of an AI so much smarter than humans, across so many domains, that it could pose an existential threat to us.

The idea of a "superintelligent" and malevolent AI has been taken very seriously by some technology companies, notably OpenAI, and has elevated Bostrom to a key figure in the "AI safety" movement. But the approach has also been ridiculed by many as overly pessimistic and not grounded in reality.

It is unclear whether criticisms of being overly gloomy have got under Bostrom's skin, but he has turned his attention to far rosier futures in his new book, *Deep Utopia: Life and meaning in a solved world*. Here, Bostrom draws the contours of what our possible futures might look like, assuming the breathless hype around AI turns out to be true. The book isn't a conventional philosophical tome: it is structured as a series of lectures to fictional students, sometimes turning into a Socratic dialogue, with occasional digressions into letters written from the perspective of a worried fox.



The writing is often clunky and there are some painful comedic asides, but there are enough fresh ideas in the book to make it a stimulating read. Bostrom asks how the economics of a post-work society might function, what kinds of utopia could exist and whether it will be possible to find meaning and purpose in a world where machines can do everything for us.

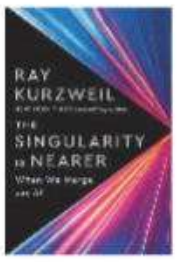
Like *Superintelligence*, though, it falters in its core assumption that human-like artificial general intelligence (AGI) can be achieved, and superhumanly so. Many other eyebrow-raising suggestions, such as uploading our minds to the cloud, are also explored. But they, like the book, feel more like thought experiments than a handy guide to how the future might be. It should also be noted that, last year, emails written by Bostrom came to light that contained racist comments about IQ. Earlier this year, the University of Oxford closed the Future of Humanity Institute, the department Bostrom headed, and he subsequently resigned from the university.

Ray Kurzweil is another grandee among those predicting AI futures and a believer in the possibility of radical change. He is most famous for the precise predictions in his 2005 book *The Singularity is Near*, where he wrote that, by 2029, we will be able to create machines that pass the Turing test and that, by 2045, non-human intelligence will be so powerful that it will be able to self-improve and merge with humans – the so-called "singularity".

"Guarding against the worst future AIs means rethinking our human values, says ethicist Shannon Vallor"

In his new book, *The Singularity is Nearer: When we merge with AI,* Kurzweil not only re-emphasises his predictions but adds that,

according to the evidence, he may have been too cautious. Sudden jumps in apparent intelligence – such as in image recognition or, more recently, with large language models – are evidence that his 2029 prediction is still on track, he says. We are now in the "steep part of the exponential" curve, he writes, which means that all of Kurzweil's prior predictions about superhuman intelligence will be rushing towards us ever faster.



While this is apparently good news for the accuracy of his predictions, there is little by way of fresh ideas in his new book. There is a useful overview of AI history, as well as brief accounts of many new, exciting technologies, from fusion to biotechnology, but the distinct lack of caution or effort in examining whether human intelligence is something that can be extracted into a machine leaves the book feeling one-dimensional.

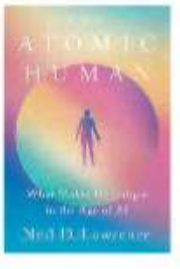
Neil Lawrence, professor of machine learning at the University of Cambridge, thinks that Kurzweil and Bostrom's ideas about superintelligence and singularities are flawed. "They misrepresent intelligence as a unidimensional quality and this doesn't reflect the diversity of intelligences we experience," he writes in *The Atomic Human: Understanding ourselves in the age of AI*.

Intelligence, according to Lawrence, is far grander and more subtle. It can be seen in the collective intelligence of vast groups of people, such as in the British Army, in which his grandfather fought, or through organisations like Amazon, where Lawrence was in charge of AI research for three years. AI is also toothless if it can't deal with uncertainty and work out how wrong it might be compared with the real world – something that is straightforward for humans.

Lawrence's aim is lofty: by explaining how AI came to be and rose to its current status, and by contrasting it with the ways humans function, the essential, "atomic" core of humanity and human intelligence will be exposed, separate from AI. The links and connections he makes in this mission, from the code-breaking activities of Alan Turing to Lawrence's own early days on off-shore oil rigs, are sprawling. His writing is elegant, but the bigger picture can be confusing and unclear.

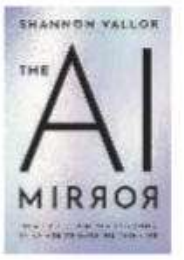
One of the more useful aspects of Lawrence's book, however, is in pouring sufficient cold water on the hype from writers like Kurzweil and Bostrom. Perhaps by design, *The Atomic Human* offers little in the way of predictions.

Shannon Vallor, a professor of ethics specialising in AI at the University of Edinburgh, UK, shares Lawrence's scepticism. In *The AI Mirror: How to reclaim our humanity in an age of machine thinking*, she goes further, asking why we can't be more imaginative. "Why do so few depictions of AGI show us a superhuman intelligence that laughs more than we do?" she asks. "Where are the intelligent machines not on a mission, but mastering being silly, goofing off, exploring, playing? Most highly intelligent creatures do a lot of this!"



Vallor isn't naive about future AIs, and she devotes a large portion of her book to the idea in its title – that AI systems are a mirror of their human makers. Mirrors, of course, don't just reflect and reveal things as they are, Vallor writes, they "also magnify, occlude, and distort what is captured in their frame". There has been a lot written about the human biases AIs can perpetuate, but to see this laid out at length, and linked to other problems like climate change or zoonotic viruses, is more than a little unnerving.

In the end, writes Vallor, the only way to guard against the worst downsides of future AI will be to rethink human values and how we design our tech. This involves shifting away from commonly prized traits like productivity and confidence, which, she argues, have steered us towards societal collapse, to more obscure virtues such as Aristotle's phronesis, a kind of wisdom that concerns practical understanding and sound judgement.



Vallor is clear on how difficult this wholesale redirection of our moral compass would be, but is nonetheless optimistic about our capacity for change, especially with a powerful enough vision, giving us the "civil courage" to collectively start repairing and rebuilding the world for others.

The questions and viewpoints in these books aren't easy to resolve: the gulf between them over what AI is and may become is frankly vast. But while this technology is difficult to understand and predict, it isn't magic. We would do well to listen to experts like Vallor or Lawrence to discover how it really works, rather than succumb to fantastical visions of the future. ▮

New Scientist *recommends*

Grace Wade
Reporter
New York

I was invited to the recent opening of **Ice Cold: An exhibition of hip-hop jewelry** at the American Museum of Natural History in New York. The display showcased lavish pieces, from

Nicki Minaj's diamond-studded "Barbie" pendant (pictured) to a hefty gold chain depicting Jesus once owned by Biggie Smalls. The collection represents the individual identities of the rappers as well as their broader impact on hip-hop and culture. It is a nice addition to the museum's extensive gems and minerals hall, especially as New York is the birthplace of hip-hop.

I have also been reading **This is Your Mind on Plants** by Michael Pollan, which explores humanity's relationship with three very different drugs: opium, caffeine and the psychedelic mescaline.

In typical Pollan style, his blend of science, history and personal anecdote makes for an enjoyable and thought-provoking read – although at times I am left wanting a bit more science and a little bit less memoir.

AMERICAN MUSEUM OF NATURAL HISTORY

The games column

Coral magic There's nothing quite like the feel of board games, especially this colourful one involving ocean ecosystems. Opponents may take the tile you wanted and scoring is fiendishly complex, but it is a great way to relax, says **Jacob Aron**

Jacob Aron is *New Scientist*'s news editor. Follow him on X @jjaron

SIDEKICK GAMES

Brilliantly coloured tiles in *Aqua* mirror the diversity of a coral reef

I'M DOING something different this month, swapping consoles for cardboard with a new board game I think *New Scientist* readers will enjoy. *Aqua: Biodiversity in the oceans* is a delightful tile-laying game for one to four players in which you match colours to build an ecosystem, starting with coral reefs, building up to small animals and eventually larger predators.

The first thing you will notice is *Aqua*'s bright artwork and chunky hexagonal tiles. Look and feel are so important in board games since part of the joy is handling physical objects rather than staring at a screen, and *Aqua* totally nails its aesthetic. The game is a riot of colour, as befits a coral reef.

Each player begins with a "hot spot" that serves as the nucleation point for their reef system. They then select tiles to add to it. Each tile is split into three colours of coral, and there must be at least one match with an existing piece to place a new one. When you complete a hexagon by matching three corals of the same colour at a point, you form a "habitat" and can put a tile on top showing the small animal that would live there, from green turtles to yellow clownfish.

This sounds simple enough, and it is – little explanation is needed to start. Where things get complicated is the scoring. As you build your habitats, there will be corals left over that don't form a trio. Any grouping of four or more count as a "reef", scoring points for any adjacent small animals. This creates a tension – do you build more habitats, and increase the number of small animals, or go for reefs, potentially scoring your small animals multiple times?

"Large animal tiles have different creatures on each side – it lets you populate the reef with whatever you like best"

But wait, there's more. If you have a group of small animals next to each other, you can take a large animal tile of the same shape and place it on top, scoring even more points. Crucially, all the small animals under the large one must be a different colour, stressing the importance of biodiversity. In a nice touch, large animal tiles have different creatures on each side, including whales and eels. This doesn't affect the game, but lets you populate the reef with what you like best. The rulebook gives a brief rundown on all the animals, if you want to know more.

The game ends after everyone has had 17 turns, at which point scoring gets even trickier. That's because at the start, each small animal is assigned to one of six "ecosystems", each with different scoring rules. One small animal might score more if, say, you have a particular large animal in your reef, or you might get extra points for three of a kind.

This scoring system has pros and cons. On the one hand, it makes it hard to count your score as you play, leaving the winner uncertain until the last moment. On the other, choosing which ecosystem goals to go for can be confusing. The game comes with 24 ecosystems, adding variety each time you play, but complicating things further.

The recommended age is 8+, and that feels about right – my 8-year-old quickly grasped it, but my younger child struggled a bit initially. That aside, we really enjoyed *Aqua*. Played solo, it is a satisfying puzzle lasting 15 minutes or so as you attempt to beat your best score or complete some of the video-game style "achievements" in the rulebook. Multiplayer games are naturally longer, but add mild tension as your opponents can take the tiles you wanted before you get to them. This is no cut-throat competition, however. Ultimately, it's a relaxing time for all involved. ▮

Game

Aqua: Biodiversity in the oceans (ages 8+)

1-4 players

Dan and Tristan Halstad

Sidekick Games

Jacob also recommends...

Games

Cascadia (ages 10+)

1-4 players

Randy Flynn

Flatout Games

Another ecosystem tile-layer, and a clear inspiration for Aqua*, this game sees you assembling habitats for elk, salmon and more in the Pacific Northwest.*

Bärenpark (ages 8+)

2-4 players

Phil Walker-Harding

Lookout Games

Build a zoo for bears, from polar to panda, by arranging Tetris*-like tiles depicting enclosures and amenities.*

Editor's pick

Saving our figures and the planet too

4 May, p 28

From Grace Bedell, Toronto, Canada

You review a new book on weight loss drugs that are taking off. Could these hold more promise than just reducing waistlines, one related to the link between food production and its impact on our planet? While many hope the drugs will make them slim, one side-effect could be that sales of fast food, highly processed food and snacks drop, assuming a lower appetite means fewer cravings for them.

If so, then perhaps this will also lead to less clearing of the biosphere for resource-greedy monocultures, plus the reduced production of tree pulp or fabrication of plastics from fossil fuels, both of which are used to package processed foods.

Direct air capture is just a drop in the ocean

25 May, p 12

From Keith Parkin, Sheffield, UK

In coverage of the direct air capture industry, you mention a plant being built to remove half a million tonnes of carbon dioxide per year from the atmosphere. This apparently impressive figure needs context.

In my youth, the colliery in my village was producing a million tonnes of coal per year, and within 20 miles were at least another eight similarly prolific mines. The current plans for carbon capture are frighteningly inadequate. I await, without holding my breath, any mention of this in the pledges for the forthcoming UK election.

Born to run? More like born to use our brains

18 May, p 11

From Geoff Harding, Sydney, Australia

It isn't surprising that there has been criticism of the idea that humans evolved to chase down prey over large distances. The need to do this regularly would suggest an inability to hunt strategically or co-operate with others, which is somewhat insulting to the developing human intelligence.

Sensible strategies would have involved the use of hunting weapons and traps or driving an animal a short distance towards an ambush by fellow hunters, with factors such as wind direction considered to avoid detection by scent. This would have been highly energy efficient and both men and women would have participated.

Why aliens probably won't bother with Dyson spheres

18 May, p 12

From Alan Worsley, Hull, East Yorkshire, UK

How feasible are Dyson spheres, signs of which may have cropped up in a survey of 5 million stars in our galaxy? The basic engineering logic behind these proposed alien structures that encircle a star to capture all its energy isn't obvious.

It makes sense that you would start building in certain ways. A narrow equatorial belt – akin to the asteroid belt or Saturn's rings – would have a degree of orbital stability for siting parts of such a structure, and components could be joined in their existing orbits. However, as soon as the structure is extended towards the poles of a sphere, this stability is lost.

From Andrew Hawkins, Peaslake, Surrey, UK

The ridiculous idea of a Dyson sphere is truly a waste of space. Any industrial beings even 500 years in advance of us would have solved any energy needs without resorting to this silly and clumsy idea. Even our own struggles to develop fusion power in order to boil water to make steam to drive a turbine to make electricity would seem like a primitive joke to them.

The easier way to simulate our reality

Letters, 11 May

From Bernd-Juergen Fischer, Berlin, Germany

Your reader Lawrence Ryan is worried that the concept that our reality is a simulation is lacking in parsimony and asks: "How much information would be required to simulate the lives, and inner lives, of more than 8 billion people?" But the simulation doesn't need to do any such thing. It only needs to simulate an "I" that believes that there are 8 billion people in the world. And for meeting one of the 8 billion, only the belief that the simulated "I" encounters some "other" with the relevant qualities needs to be simulated within the simulated "I". The same goes for the rest of the universe: only what an "I" might know needs to be simulated. It seems to me that such a simulation would be highly parsimonious compared with the exuberance of what we take for reality.

Is there no escape from environmental woes?

11 May, p 36

From Greta Blake, Darlington, County Durham, UK

In my attempts to reduce my use of single-use plastics (refilling washing-up liquid bottles, using shampoo bars, toothpaste tablets and so on), I bought paper bags and greaseproof paper bags for packed lunches instead.

Having just read your article on "forever chemicals", I am now wondering if I have substituted one problem for another. Which is doing most harm to me and to the environment: the plastics or the paper/greaseproof bags? We just can't win, can we.

Getting older but I certainly don't feel it

18 May, p 32

From Maggie Cobbett, Ripon, North Yorkshire, UK

Thank you for your look at the ageing mindset. Although, at least according to this, I am already at the age when people start to acknowledge that they are old, I certainly don't feel that way.

Maybe that is due in part to having a wide circle of friends, some decades younger than I am. They will never hear phrases like "in my day" from me. My only issue is when the perceptions of others get in the way of things I want to do.

Although I have never had as much as a speeding ticket in all the years I have driven, when asking about hiring a van, I found my age ruled me out. Car hire on holiday also gets harder with each passing birthday. Still, if I am able to carry on as long as my grandmother did, I have another quarter of a century to look forward to and I intend to make the most of it. I still see this very much as my day.

From Gerard Buzolic, Coolum Beach, Queensland, Australia

Your article reminds us not to stereotype all older people as frail, lonely or incapable. Ageism is one of many forms of labelling. Any group is in danger of that. It can serve a purpose by making us alert to specific needs, like offering an older person a seat on public transport. But when meeting an individual, it is good to be open-minded and let the labels go.

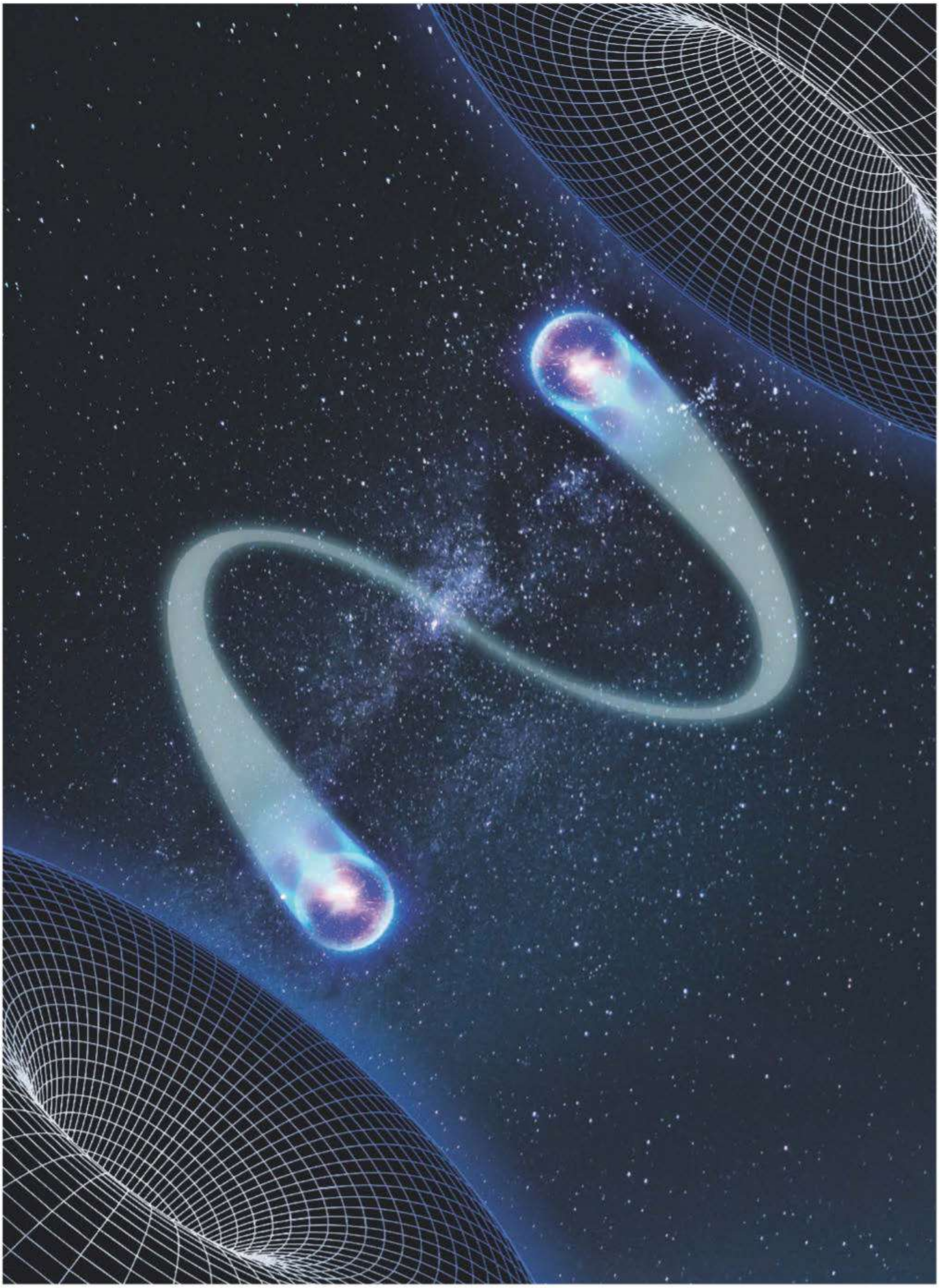
Want to get in touch?

Send letters to letters@newscientist.com; see terms at newscientist.com/letters

Letters sent to New Scientist, 9 Derry Street, London, W8 5HY will be delayed

For the record

The solution diagram for BrainTwister #14 (13 April, p 47) was missing lines from 3 and 6 to 18.



RYAN WILLS/ISTOCK/AMTITUS

A loop in time

An experiment to send a particle back in time could transform our understanding of the subatomic realm, finds **Miriam Frankel**

WHEN Seth Lloyd first published his ideas about quantum time loops, he hadn't considered all the consequences. For one thing, he hadn't anticipated the countless emails he would get from would-be time travellers asking for his help. If he could have his time over again, he jokes, he "probably wouldn't have done it".

Sadly, Lloyd, a physicist at the Massachusetts Institute of Technology, won't be revisiting years gone by. Spoiler alert: no one will go back in time during the course of this article. But particles? That is another matter.

Theoretical routes to the past called time loops have long been hypothesised by physicists. But because they are plagued by impracticalities and paradoxes, they have been dismissed as impossible for just as long. But now Lloyd and other physicists have begun to show that in the quantum realm, these loops to the past are not only possible, but even experimentally feasible. In other words, we will soon effectively try to send a particle back in time.

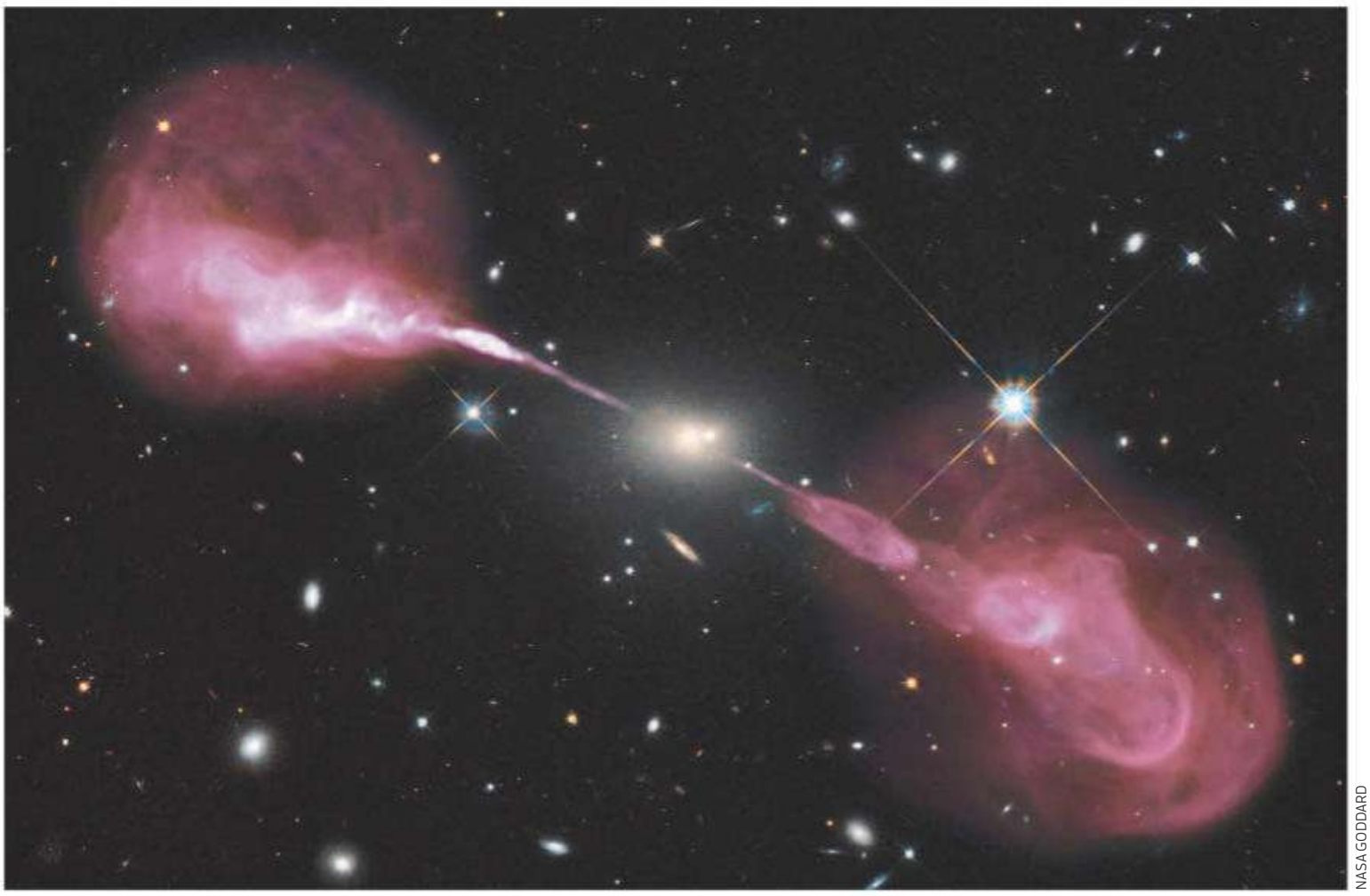
If that succeeds, it raises the possibility of being able to dispatch, if not people, then at least messages in the form of quantum signals, back in time. More importantly, studying this phenomenon takes us to the heart of how cause and effect really work, what quantum theory means and perhaps even how we can create a successor theory that more fully captures the true nature of reality.

In physics, time loops are more properly known as closed time-like curves (CTCs). They first arose in Albert Einstein's theory of general relativity, which says space-time can bend. Hypothetically, if you could curve it enough, it would close in on itself, creating a pathway to the past. The only fly in the ointment is that generating such extreme curvature would require something with a heck of a lot of mass rotating very fast. In practice, that probably means a black hole – not exactly something we could create in a lab.

Then again, all of that applies to relatively large time loops, the sort of thing a human could – in principle – jump into. But what about something that instead operates at the tiniest scales? Breakthrough experiments in quantum mechanics, the strange set of laws that governs reality at the subatomic level, have shown we could conceivably make the mathematical equivalent of a time loop in this domain. It would be called a quantum CTC.

For a long time, physicists snorted at the idea of a time loop in the quantum realm, largely because it isn't compatible with the way time is thought to operate in this framework. Time is believed to work startlingly differently in quantum mechanics compared with general relativity. Indeed, this disjoint is one of the biggest hurdles physicists face in trying to unite relativity and quantum mechanics, to find a theory that describes reality on every scale.

In relativity, time and space are intertwined in the fabric of space-time, so time can contract and stretch under the influence of gravity. In quantum mechanics, on the other hand, time is usually conceived of as a clock that ticks immutably in the background – and cause always precedes effect. ›



NASA GODDARD

Black holes like the one at the heart of the Hercules A galaxy could create a form of time loop

It might sound like that rules out quantum CTCs altogether. But an increasingly popular take on quantum mechanics sees time in a different way. This approach, called retrocausality, came about because of disagreements over how to think about another peculiar feature of quantum mechanics called entanglement.

When two particles are entangled, they share a quantum state even if they are light years apart. Measure one's momentum, for example, and you instantly know that of the other. If these entangled particles were communicating with each other, this exchange must happen at faster-than-light speed, which relativity forbids. Einstein – who was suspicious of entanglement – argued that the outcome must be predetermined, but this has been ruled out again and again in experiments.

The result is usually taken to mean that entanglement challenges our notion of locality – the idea that the space between objects matters. In other words, it is taken as proof that quantum mechanics is "non-local": it doesn't care about distances.

In contrast, retrocausality casts entanglement as a connection through time. In this interpretation, when you measure one entangled particle, a signal is sent back to the time it was entangled and simply carried forwards with the other particle, doing away with the need for instantaneous information transfer over vast distances. Locality is preserved, but standard causality is ditched.

Although we don't know which interpretation is correct, the prevailing view has long been that quantum mechanics is non-local, while retrocausality has remained mostly philosophical. But this has started to change, and with it the possibilities for quantum time loops have opened up.

In 1991, David Deutsch, a theoretical physicist at the University of Oxford, used retrocausality to propose a quantum CTC. Deutsch tried to use aspects of quantum physics to get around any paradoxes involving cause and effect, such as the grandfather paradox, which throws up the conundrum of a time traveller going back in time and killing their own ancestor, thus negating their own existence. Deutsch's version was inspired by the many-worlds interpretation of quantum mechanics: he argued that a time-travelling particle that went back and destroyed itself would simply enter another strand of the multiverse. But others felt this didn't resolve the paradox.

Quantum trick

Fast forward to 2010, when Lloyd and his colleagues published an updated version of a quantum CTC without the need to invoke other universes. Their version works using a trick in quantum computing called "post-selection", which means running a lot of computations or measurements and throwing out the ones without the result you wanted. In the quantum world, there is always an element of uncertainty – particles exist in a cloud of possible states until someone measures them. So, the team proposed a way to use post-selection and entanglement to go back and change things that were never measured in the past. It is important to note, says Lloyd, that something with a definite outcome in the past can't be changed. Bad news for the many people who email him wanting to dabble in time travel.

It turns out that Lloyd's version of a quantum CTC can be incredibly useful, albeit in what at first seems like a more mundane domain. Its utility is related to metrology, the science of measurement. This is an area in which quantum mechanics has become increasingly handy in recent years. Using quantum mechanical systems, we can measure things like magnetic fields, light and even gravitational waves to accuracies we could never reach using classical physics.

But one big question is how to set up such measurement experiments. Often, you don't have the information you need to do this, like the direction of a magnetic field, for example. Without this knowledge, you don't know how to prepare a particle to best measure it. "It would be awfully nice if we could teleport that information backward in time," says Nicole Yunger Halpern at the University of Maryland. Halpern was working on this dilemma, along with David Arvidsson-Shukur at the University of Cambridge and Aidan McConnell at the Swiss Federal Institute of Technology in Zurich, when she came across Lloyd's CTC idea.

This provided the spark that allowed the trio to resolve this metrology problem. In 2023, they published a thought experiment outlining how you could effectively use particles to create the kind of time loop

Lloyd had suggested. It involves four qubits, the quantum computing equivalent of a classical bit. Qubits can be individual particles or groups of atoms, but, for the sake of argument, let's make them electrons and call them A, B, C and D.

The thought experiment involves this set of particles being entangled and measured in a special sequence (see diagram, below). To simplify things, the team likes to think of it using the analogy of someone planning to send a gift to their friend, knowing it will take three days to deliver. They send the gift on day one, but, annoyingly, receive their friend's wish list on day two. They then send a message back in time to tweak the gift that was dispatched, meaning the friend gets what they wanted through the power of time travel.

In the real thought experiment, the gift is particle A, while the "wish list" corresponds to knowledge of a quantum mechanical property of particle C called spin. Once this is known, the experimenters use particle D to connect backwards in time and influence the properties of particle A so that it aligns with those of particle C.

For technical reasons, this process actually only works 1 in 4 times. The other results are thrown out in the post-selection process. This might seem like cheating, but still, the researchers argue, the thought experiment involves making a measurement that determines something in the past. In quantum mechanics, this is mathematically equivalent to sending the state back in time. Particle A's past state is determined by a condition set in a future experiment.

"I like what they're doing," says Emily Adlam, a philosopher at Chapman University in California. But it isn't truly retrocausal, she says – if it were, it would work all of the time. "What's really going on is that you threw away all the experiments that had the wrong result."

Adlam also notes that this result is only a thought experiment – nothing has really been sent back in time. But since Arvidsson-Shukur and his colleagues published this idea, they have designed an actual experiment with physicist Aephraim Steinberg at the University of Toronto in Canada. This will involve sending real individual photons through a quantum time loop.

In the meantime, Arvidsson-Shukur and his colleagues have made great progress on their original goal. They are starting to make better measurements using quantum time loops.

"Physicists have long talked about sending quantum information to the past. What's great about this research is it's not talk – it's action"

In an experiment published in March this year, they showed it is possible to improve the efficiency of a quantum processor using a CTC simulation. To get the gist of the experiment, imagine you are stargazing with a friend and they spot a shooting star that you miss. This latest experiment is like you going back in time to look in the right direction. And this time, they did it without throwing away any results.

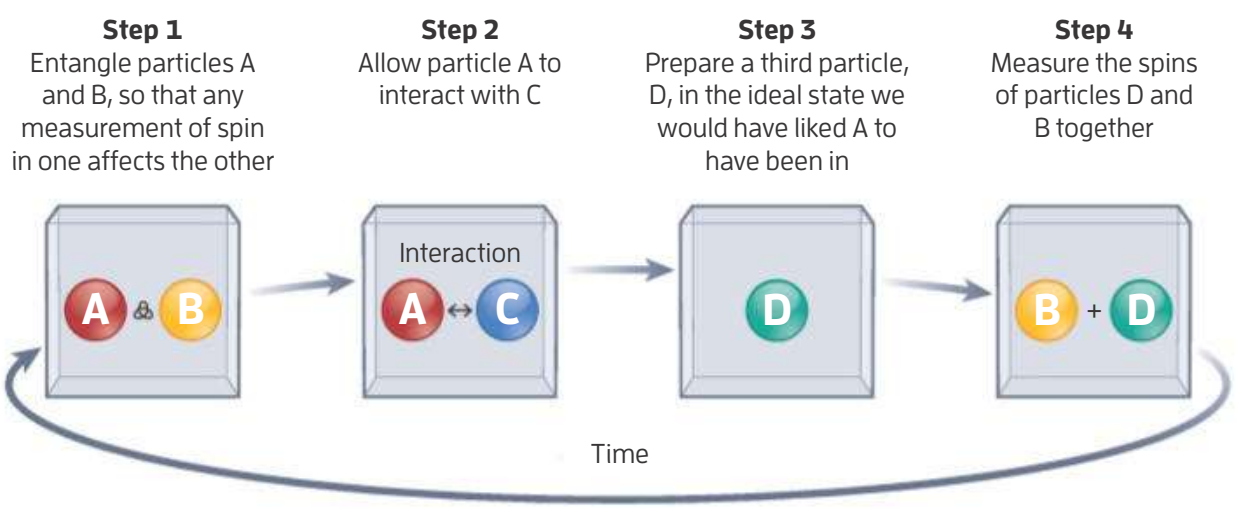
Unknown fields

To do that, Arvidsson-Shukur and his colleagues designed an experiment involving two atoms set up as superconducting qubits and an unknown field that could be electric, magnetic or something else. They wanted to monitor changes in one of the qubits' spin, to estimate the unknown field's strength. If they didn't know the field's direction, they didn't know how to prepare the spin. The solution to these kinds of problems is normally to prepare many different qubits with different spins and to use that to work out the field. But this approach involves time-consuming preparation of many electrons that are discarded before the measurement.

A better approach is to send that state back in time using entanglement. In the experiment, one of two entangled qubits was placed under the influence of the field. Then, the researchers prepared a measurement on the entangled partner to send that optimal state back in time to the qubit in the field. ›

Loop the loop

A thought experiment involving entangled quantum particles shows how to influence the past. In the retrocausal interpretation of quantum mechanics, entanglement can reach backwards in time. This allows the most precise measurement of particle C's spin, a quantum mechanical property.


Step 1
Entangle particles A and B, so that any measurement of spin in one affects the other
Step 2
Allow particle A to interact with C
Step 3
Prepare a third particle, D, in the ideal state we would have liked A to have been in
Step 4
Measure the spins of particles D and B together
A & B
Interaction
A ↔ C
D
B + D
Time

Retrocausality predicts that, since B is already entangled with A, it will influence its spin backwards in time

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Lloyd, for one, is impressed. Physicists have long talked about sending quantum information to the past, he says. "What's great about this paper is it's not talk – it's action."

He points out that this could have all sorts of technological advantages, including in quantum computing. He also says it could be useful in game theory, a type of mathematics that models strategic decisions. He suggests a game with several players, or particles that make interdependent decisions. With access to a simulated time loop, he says, the players couldn't cheat.

Zooming out, this work may be a reason to take the retrocausal interpretation of quantum mechanics more seriously. "It's great that people in quantum information are recognising the benefits of thinking about these experiments in this alternate way of interpreting entanglement as influences that extend back in time," says Ken Wharton, a quantum physicist at San José State University in California who has long been an advocate of retrocausality. "It is telling that they are being inspired by this alternate viewpoint and getting some neat results." If retrocausality is correct, it means time travel is already ubiquitous in the quantum realm.

Retrocausality has the added benefit of being a step towards aligning the approaches to time taken in quantum mechanics and general relativity – something that has to be done if we are ever to come up with a theory of quantum gravity that unites the two. Having a good model of how CTCs work in quantum mechanics would be a huge step towards creating and testing models of quantum gravity, since researchers believe any such theory has to treat time on an equal footing both in relativity and quantum mechanics.

> "If retrocausality is correct, time travel is already ubiquitous in the quantum realm"

Tweak the past

If researchers succeed in creating quantum time loops, could we send people back in time one day? That is the sort of question Lloyd gets often, and unfortunately he has to be a killjoy. Quantum states, including entanglement, are extremely fragile. This is why quantum experiments are often carried out on single atoms in a vacuum – even a passing air molecule could disrupt a state. To correlate the millions of atoms in our bodies in the present and entangle all of them with the millions of atoms in our self in the past is completely unrealistic. "I would say it will be impossible to ever build a lab good enough," says Arvidsson-Shukur.

We may, however, be able to use quantum time travel to subtly but usefully tweak the past. Imagine setting up a pair of entangled particles and preserving them in perpetuity. This could act as a kind of waymarker in time. Physicists in the future could use retrocausality to tweak the state of the particles, influencing the result that physicists in the past would get if they measured them. This could never directly alter an awful past event in the real world, like an accident. But perhaps you could link the outcome of the quantum measurement to the real world and so – in theory – change the course of history.

Imagine, for example, a quantum CTC version of the Schrödinger's cat thought experiment. The cat is in a box with a vial of poison that is controlled by a quantum particle in a superposition of two states, only one of which will release the toxin. The cat is considered dead and alive at the same time, until the box is opened, at which point we have measured the particle and it assumes one of its two possible states. There is a chance a quantum CTC could change the outcome and hence the cat's fate. If we could send the optimal state back in time, we could potentially save our furry friend. ▮

Quantum time loops couldn't send people through time

AMBLIN ENTERTAINMENT/UNIVERSAL PICTURES/KOBAL/SHUTTERSTOCK

Miriam Frankel is a freelance journalist based in London

NATALIE FOSS

‘We simply cannot continue to eat the way we do’

Behavioural scientist Sophie Attwood is trying to nudge us to make more sustainable food choices. She tells **Graham Lawton** how it is done

WHAT we eat has a huge impact not just on our health, but also on that of the planet. This is common knowledge. Yet despite a smorgasbord of studies telling us which foods we should and shouldn't consume, many of us find it hard to do the right thing. Sophie Attwood's research takes a different approach: rather than presenting the bare facts on diet and its contribution to climate change, she uses behavioural science to persuade people to choose greener options. In May, she and her colleagues at global sustainability think tank the World Resources Institute released a major report on how the food industry can nudge people towards more sustainable fare. The aim isn't to browbeat consumers, but to increase the appeal of plant-based options and reduce our desire to choose meat.

FG TRADE LATIN/GETTY IMAGES

Graham Lawton: How much of a problem are unsustainable diets for the climate?
Sophie Attwood: Massive. The type of food people eat is the biggest cause of climate change related to diet. A lot of people think it's stuff like food miles and pesticides. It's actually not. It's beef, for multiple reasons, the main one being that cattle often get fed on soya. Soya is usually from deforested areas, so you have to cut down the rainforest. And then you need around 20 kilograms of soya to produce 1 kilogram of beef. It's a highly inefficient way to produce calories. Aside from that, the cattle themselves emit a lot of methane from gut fermentation and nitrogen from manure. There are greenhouse gases along the entire chain.

We simply cannot continue to eat the way we do, be able to feed everybody and keep the natural environment. We're at the point where we need to do everything very quickly.

So what is a sustainable diet?
It's not necessarily a meat-free diet. It's just a radically reduced amount of meat – especially beef. The average level of beef an individual eats in high-consuming regions, such as Europe and America, is somewhere around [the equivalent of] three burgers a week. We need to get that down to about one and a half.

How can your research help?
We work with lots of companies in the food service sector – restaurants, takeaways, canteens and catering companies. They are a really strong entry point into influencing people. We find all the different behavioural science techniques that can be done, everything from marketing and product placement to nudging. We work with the companies to implement these and see if we get a change in consumer choices. And then we conduct a lot of experiments so we've got evidence that it works.

What are the most effective tools to encourage consumers to shift their diets?
In 2018, we published a huge review looking at everything that had been done in behavioural science to try to shift diets. We found 57 behaviour change techniques. Using indulgent, taste-focused language came out as the big one. So don't talk about plant-based food being vegetarian or vegan because it really puts people off. Ignore the fact that it doesn't contain meat, just talk up the positive attributes. I haven't seen a study where it doesn't work.

Have things moved on since 2018?
We've just redone the exercise, and this time around we found 90 techniques. Language still comes out quite strongly. Another is menu engineering. The way you structure a menu and the content and the design have a massive influence on what people choose. The classic one is that things at the top left of the menu get chosen more. People's food choices are quite easily influenced.

What other techniques are there?
Take any images of meat off the menu because they prompt people to choose meat. And put the plant-rich dishes into the main body of the menu, as meat-eaters will tend to ignore a veggie section.

One that works all the time is taking meat off the menu. Restaurants present a plant-based-only menu and you have to ask the server for meat, a bit like what we did for cigarettes when we put them behind the counter. That one works a tonne, but for businesses trying to sell food and stay in business, it's seen as not that feasible.

Or you do things like a pre-order form for events, so when you go to an event,

Where food is placed on a menu influences how often it is chosen, which can help people to reduce their meat consumption

SUSAN E. DEGGINGER/ALAMY

you have a default plant-based menu unless you opt in to meat.

Menu language and menu engineering have worked really well. It's about a 10 per cent shift in choices, which is pretty substantial.

Does health messaging also work?
This is quite interesting. Something like 80 studies in our review look at health messaging. Researchers have spent years looking at it. Just don't bother. It doesn't work.

What's the most surprising nudge?
Natural sounds like birdsong calm people down, and people make more considered choices when they are in a calmer rather than an emotionally aroused state.

What about making plant-based meals cheaper?
Yeah, people are sensitive to price. We know incentives work, but industry needs to find a way to implement them that doesn't dent their business. There's also a point at which you need to ensure that you're not signalling it's a worse-quality product.

If you want people to change, you have to offer good-quality, really tasty plant-based options. Restaurants need to get on board with doing a lot more product redevelopment and offer chefs training in plant-based foods because, at the moment, they don't get trained in that.

How receptive are food service companies to this kind of approach?
It usually lands very positively. Chefs are creatives. It's basically saying to chefs, please be creative. And they really would like to be the conduit for healthier and more sustainable choices.

How do you respond to a business that says, what's in it for us?
A lot of the Gen Z cohort [born from around the mid-1990s to early 2010s] – and probably a lot of everybody else – are now becoming much more aware of the link between diet and climate, so demand for more and better-quality plant-based foods is really growing. It does make good sense for businesses to be ahead of that curve. They also have the benefit of being able to sell environmental credentials.

"Natural birdsong calms people down and they make more considered choices"

One thing you're fighting against here is the meat industry, which has been lobbying hard to rebrand itself as sustainable. How do you push back against corporate might?
I'm not sure we can. You can't push back against massive budgets. To be honest, the industry is not pro-environmental and it never will be. They can make positive changes, like trying to get cows to emit less methane, which is welcome. But the big thing people need to do is cut some meat out of their diet.

Can individual choices really shift the dial?
That's a good point. But think about the accumulated impact: 8 billion people are eating three meals a day. So if you can get even a slight change, it scales up. It's actually one of the most substantially important things you can do, and it's not a big thing, it's not costly, it's not a huge time investment. It's basically impossible to get where we need to go without it. ▮

Graham Lawton is a features writer at *New Scientist*

Better connected

How to win friends and influence people? It is a perennial question, but science now has the answer, finds **David Robson**

IF YOU were to take one step to improve your health, what would it be: change what you eat, be more active or invest more time in your friendships?

Most people know that diet and exercise have huge impacts on well-being. Fewer realise that social connection is just as important. A slew of studies has shown that feeling supported and loved can help protect you from common conditions, including diabetes, Alzheimer's disease, stroke and heart attack. And the benefits don't end there. In the workplace, good relationships are linked with greater creativity and job satisfaction – and a lower risk of burnout.

The obvious upshot is that we should put more effort into building strong and meaningful relationships. But many people find the idea of supercharging their social lives daunting. Up to now, science hasn't been of much practical help because research was focused on environmental factors linked with loneliness, such as increasing urbanisation and reliance on technology. That might help explain why people seeking the secrets of better connection often turn to self-help gurus, whose advice is based on anecdote rather than data. But now there is a better way to think about this problem.

In recent years, researchers have made great strides in revealing the psychological

JOEL REDMAN/GALLERY STOCK

"We tend to underestimate how well we have come across to others"

barriers that undermine our attempts to build good relationships, and in discovering ways to overcome them. As I explain in my new book, *The Laws of Connection: 13 social strategies that will change your life*, most of us are needlessly pessimistic about our capacity to build bridges with those around us, and it is often surprisingly simple to cultivate better habits.

One early insight in this new field of research goes to the heart of how psychological biases can sabotage our social lives. Like many of the best scientific findings, it was inspired by a personal experience. One day, a few years ago, psychologist Erica Boothby was talking to a new acquaintance while her partner and collaborator Gus Cooney stood nearby. She enjoyed the chat and warmed to the other person, but she worried that she had made a bad impression. To Cooney's ears, however, the conversation had gone swimmingly. Discussing this afterwards, Boothby and Cooney, both at the University of Pennsylvania, wondered whether most of us tend to underestimate how well we have come across when we engage with someone new. So they decided to put the idea to the test.

To do that, they got pairs of people to chat for 5 minutes. Then, each person had to rate their agreement with a series of statements concerning their perceptions of their partner on a scale of 1 to 7. The statements were things like "I generally liked the other participant" and "I could see myself becoming friends with the other participant". They also rated similar statements about the other person's perceptions of them, such as "the other participant generally liked me" and "the other participant could see themself becoming friends with me".

As Boothby and Cooney had suspected, most people were overly pessimistic about their ability to connect. They believed that their partner liked them less than they liked their partner when, in fact, their warm feelings tended to be reciprocated. Boothby and Cooney dubbed this psychological bias the "liking gap", and the experiments they followed up with showed that it can linger way beyond first impressions. In one survey of undergraduates, for example, students continued to underestimate how much their roommates liked them for up to eight months after they met.

Do you like me?

The source of our social self-doubt isn't entirely clear. Studies by Wouter Wolf at Utrecht University in the Netherlands suggest that it often emerges at around the age of 5, when we start understanding the concept of politeness and the idea that people might be hiding their true feelings. Whatever its cause, the liking gap might discourage us from following up on a pleasant conversation with a text or an email, or from making fruitful collaborations at work. Moreover, our reserved behaviour may confirm the other person's perception that we don't like them as much as they like us, eroding their social confidence.

Since the liking gap was discovered, the list of psychological barriers to social connection has grown substantially. Most of these biases do their damage by undermining the foundation upon which all close relationships are based – what researchers call "shared reality". This is the sense that we experience the world in the same way as another person.

The power of shared reality can be seen in an experiment carried out by Maya Rossignac-Milon at the University of Navarra in Spain. Working with Boothby and others, she placed around 200 participants into pairs and got them to discuss the events depicted in a series of ambiguous film clips. After 12 minutes, they were asked to rate their agreement with a series of statements designed to measure their sense of shared reality, such as "we saw the world in the same way" and "we often anticipated what the other was about to say". Rossignac-Milon found that these scores could predict a participant's overall feelings for the other person: the higher the score, the more they trusted the other person's judgement and wanted to continue the discussion. In other words, the more they felt they had "clicked".

Multiple studies have replicated this ›

finding. Whether we are considering close friends, romantic partners or passing acquaintances, the sense of shared reality predicts how close we will feel to someone. However, flawed social intuitions, such as those demonstrated by the liking gap, can lead us to act in ways that erode this sense of shared reality.

For instance, a natural tendency for egocentric thinking can prevent us from effectively signalling our attention to others. When in conversation, we tend to rely too much on body language and so-called paralinguistic signals, such as murmuring assent, to show that we have heard the speaker and agree with them. We assume that these cues will be read in the way we intend them to be understood. However, it is easy to fake such responses while your mind is wandering elsewhere, so others don't necessarily trust them, and this can weaken their sense of shared reality. For this reason, it is much better to demonstrate your attention explicitly in words. Try paraphrasing what someone has just expressed – because that is very hard to do if you haven't been listening. And if you agree with their viewpoint, be sure to express that validation verbally, rather than simply nodding.

You might also consider whether your conversations tackle the right type of subject matter to allow a shared reality to develop. Due to our natural reserve, many of us stick to superficial topics that skate over the more important issues in life. Research shows that when we share our intimate thoughts and feelings, this can put us on an accelerated path to intimacy. Yet most of us are reluctant to do this, as a team led by Michael Kardas at Oklahoma State University found in a study that encouraged "self-disclosure".

"A vibrant social life can reduce your risk of premature death by 30%"

Participants were placed in pairs and given a set of conversation prompts designed to promote greater connection, such as "for what in your life do you feel most grateful?" and "if a crystal ball could tell you the truth about yourself, your life, your future or anything else, what would you want to know?" Beforehand, people worried that the conversation would be extremely awkward compared with standard small talk about someone's background or what they did on a public holiday. They were also concerned that their partner would have little interest

PETRI OESCHGER/GETTY IMAGES

Sharing achievements with other people can strengthen social bonds

Why friends are good for your health

The benefits of a vibrant social life can seem unbelievable. According to an analysis of the results of many studies, it could reduce your risk of premature death by as much as 30 per cent. Conversely, lacking strong social relations is as bad for your health as being overweight, physically inactive or drinking too much alcohol (see main story).

There are many potential mechanisms through which connection results in such effects. One is that social support helps to soothe life's stresses via emotional and practical means. Friends can give you a lift to the doctors when you are sick, for example, or provide childcare when you need to work extra hours.

It is also possible that loneliness is itself dangerous because humans have an evolved response to social exclusion. If our prehistoric ancestors were alone in the wild, they were at increased risk of attack by predators, so they may have adapted by releasing inflammatory chemicals that reduce the chance of infection from injury. While this would have improved short-term survival in the past, it increases our chances of stroke and heart attack today.

Given all this, it is no wonder medical authorities are now paying serious attention to the importance of relationships. The World Health Organization, for example, has just founded a Commission on Social Connection. Its aim is to raise awareness of loneliness as a global public health priority.

in hearing their intimate thoughts and feelings. In reality, the encounter wasn't nearly as uncomfortable as they feared. Participants found themselves caring more about the content of the conversation and feeling closer to the other person than they had expected. In other words, the creation of a shared reality was much easier than they had anticipated.

A related psychological barrier sabotaging our ability to connect through communication is called the "beautiful mess effect". Imagine that you are preoccupied by a failure at work, for instance. Most of us assume that if we share such worries by speaking with colleagues, say, they will see our confessions as weakness. In fact, people are more likely to appreciate our honesty and recognise the courage in speaking up, according to research by Anna Bruk at the University of Mannheim, Germany, and her colleagues. If we had a little more faith in the empathy of others, we may be surprised by the support we would receive.

RYAN BRABAZON/KINTZING

A shared reality can help you form romantic connections

The gratitude gap

Similarly, most people hold back when it comes to telling others how much they appreciate them, fearing that such compliments will sound ingratiating and unctuous, but the kind words are mostly welcomed – and the people giving and receiving them end up feeling much happier after the interaction. This bias, which I call the gratitude gap, prevents our acquaintances from knowing how much we notice and value their better qualities, which again undermines shared reality. Perhaps more surprisingly, so does our reluctance to share our own strengths and achievements. We fear that we will seem boastful, but this can backfire in the long run. When the other person discovers your good news from another source, your previous modesty seems paternalistic and insulting, as if you don't trust them to cope with the jealousy that your success might provoke. The truth is that people are much more likely to feel confelicity – vicarious happiness – than we expect. It is simply another form of shared reality that can strengthen our bonds.

The mere awareness of these biases can put you on the path to correcting them. In many cases, however, you must also make a conscious decision to change your behaviour. One proven way to do this is with "implementation intentions", which take the form of statements that set out a concrete plan of action. For example, imagine that you have decided to make more effort to meet new people – an excellent starting point for anyone who wishes to supercharge their social life. You might have the vague goal of "talking to strangers", but you also need some specific strategies dictating when, where and how you will do that. Your implementation plan could be as simple as "when I am queuing for lunch, I will exchange a few words with the person next to me" or "next time I am at the supermarket, I will offer to help someone carry their shopping to the car".

You might feel some nerves the first time you put this into practice. You will probably overestimate how awkward the interaction will be and underestimate how much you will enjoy the exchange. But these anxieties will dissipate with time, as Gillian Sandstrom at the University of Sussex, UK, has shown. Working with Boothby and Cooney, she set participants a week-long "scavenger hunt", which involved finding different kinds of people – such as someone with a tattoo or someone who looks artistic – and then striking up a conversation with them. By the end of the fifth day, the participants had much more positive attitudes about talking to strangers: they anticipated less rejection and awkwardness and felt more confident in their conversational ability.

Needless to say, you should respect other's wishes to be left in solitude if they show no interest in a conversation. Fortunately, though, the research suggests this is much less likely than we imagine. Most people welcome the chance to converse with others in their community, they are just too shy to make the first move themselves.

Of course, some of us are shyer than others. But you need not fear that your personality will prevent you from tapping into the new science of social connection. Research shows that both introverts and extroverts get a boost in well-being from acting a little more gregariously (see "Why friends are good for your health", left). The big difference appears to be in initial expectations: introverts tend to be especially prone to those negative predictions about how much they will enjoy socialising. Once they have taken the plunge, however, they find just as much pleasure in their interactions as extroverts.

Having immersed myself in this research for more than three years while writing my book, I am convinced that we all have the potential to find greater connection, along with all the benefits for our health, happiness and creativity that it brings. The social life you crave is closer than you think. ▮

David Robson is a writer based in London. His new book *The Laws of Connection* will be published in June

The back pages

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Mathematics of life

What are the chances?

The Monty Hall problem shows how important it is to take care when judging the odds, in science and life, says **Peter Rowlett**

Peter Rowlett is a mathematics lecturer, podcaster and author based at Sheffield Hallam University, UK. Follow him @peterrowlett

Mathematics of life reveals the mathematical ideas and shortcuts behind everyday situations. It appears monthly

Next week
Debunking gardening myths

CALCULATING probabilities can be tricky, with subtle changes in context giving quite different results. I was reminded of this recently after setting BrainTwister #10 for *New Scientist* readers, which was about the odds of seating two pairs of people adjacently in a row of 22 chairs.

Several readers wrote to say my solution was wrong. I had figured out all the possible seating arrangements and counted the ones that had the two groups adjacent. The readers, meanwhile, seated one pair first and then counted the ways of seating the second pair adjacently. Neither approach was wrong, depending on how you read the question.

This subtlety with probability is illustrated nicely by the Monty Hall problem, which is based on the long-running US game show *Let's Make a Deal*. A contestant tries to guess which of three doors conceals a big prize. They guess at random, with ⅓ probability of finding the prize. In the puzzle, host Monty Hall doesn't open the chosen door. Instead, he opens one of the other doors to reveal a "zonk", an item of little value. He then offers the contestant the opportunity to switch to the remaining door or stick with their first choice.

Hall said in 1991 that the game is designed so contestants make the mistaken assumption that, since there are now two choices, their ⅓ probability has increased to ½. This, combined with a psychological preference to avoid giving up a prize already won, means people tend to stick.

SHUTTERSTOCK/JOSE LUIS STEPHENS

Marilyn vos Savant published the problem in her column in *Parade* magazine in 1990 along with the answer that you are much more likely to win if you switch. She received thousands of letters, many from mathematicians and scientists, telling her she was wrong.

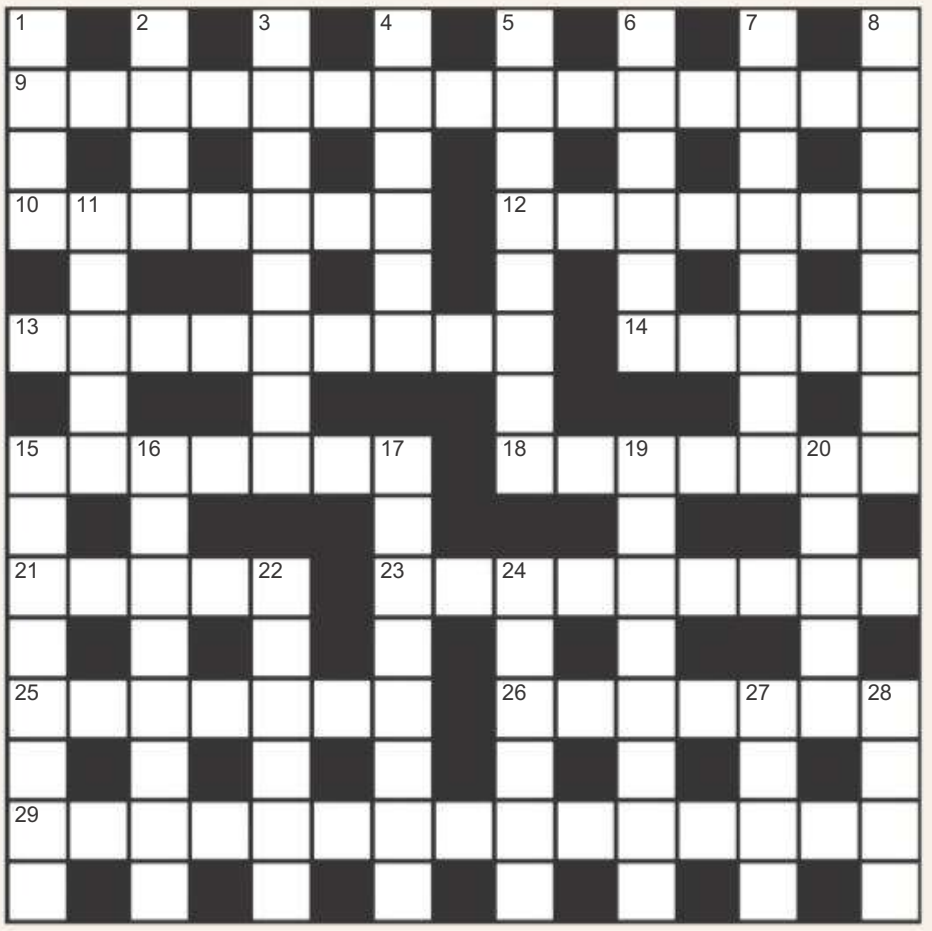
Imagine the host opened one of the unchosen doors at random: one-third of the time, they would reveal the prize. But in the remaining cases, the prize would be behind the chosen door half the time, for a probability of ½.

But that isn't really the problem being solved. The missing piece of information is that the host knows where the prize is, and of course the show must go on. There is a ⅓ probability that the prize is behind the chosen door, and therefore a ⅔ probability that it is behind one of the other two. Being shown a zonk behind one of the other two hasn't changed this set-up – the door chosen still has a probability of ⅓, so the other door carries a ⅔ probability. You should switch.

Probability problems depend on the precise question more than people realise. This is why it might seem surprising when you run into a friend, because you aren't considering the number of people you walked past and how many friends you might see. And for scientists, it is why they have to be very careful about what their evidence is really telling them. ▮

These articles are posted each week at newscientist.com/maker

Quick crossword #159 *Set by Richard Smyth*



Scribble zone

Answers and the next cryptic crossword next week

ACROSS

9 Two-eyed sight (9,6)
10 Roman siege engine (7)
12 Outer ear (7)
13 Thermal decomposition at high temperatures (9)
14 Chronometer (5)
15 Blocked passageway; impasse (4,3)
18 Relating to the eyelashes or eyelids (7)
21 Sheepish? (5)
23 Patient's version of their medical history (9)
25 Combined force of co-operating entities (7)
26 Device that measures current (7)
29 Hydrodynamic machine (10,5)

DOWN

1 Bird that may be scarlet or sacred (4)
2 Reverse a command, in computing (4)
3 Shoulder blades (8)
4 Brass and bronze, say (6)
5 First period of the Mesozoic Era (8)
6 ___ acid, $HOC(CO_2H)(CH_2CO_2H)_2$ (6)
7 Tree from which quinine is derived (8)
8 Button often pressed to execute a computing command (5,3)
11 UK river formerly famed for shipbuilding (5)
15 ___ Clock, symbol maintained by the *Bulletin of the Atomic Scientists* (8)
16 Aircraft electronics (8)
17 Artificial kidney (8)
19 Island or continent, perhaps (8)
20 Elevate (5)
22 Insect in the order Dermaptera (6)
24 Shrub in the genus *Rhododendron* (6)
27 Rotate; change direction (4)
28 In a spreadsheet, not columns (4)

Our crosswords are now solvable online
newscientist.com/crosswords

Quick quiz #254
set by Bethan Ackerley

1 The appearance of new skin lesions on lines of previous trauma is known as what?

2 Cornicles are found on the dorsal side of which insects?

3 In what year was the Indian Space Research Organisation founded?

4 Where in the body would you find the ileocaecal valve?

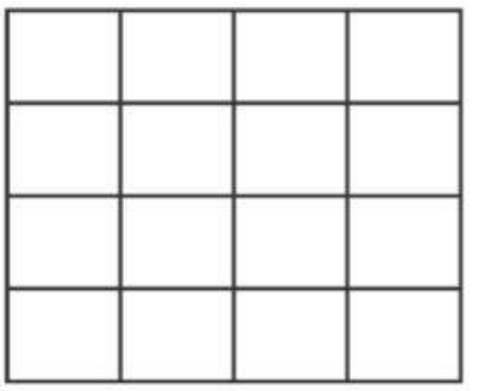
5 In botany, what collective name is given to a plant's sepals?

Answers on page 47

BrainTwister
set by Peter Rowlett
#22 Even rows

Fill in the numbers 1-16 once each in a four-by-four grid so that the sum of the numbers on the top row is even and the numbers on the bottom row sum to a different even number.

For example, if we arrange the square so that the numbers across the top row are 1, 2, 3 and 4, they will sum to an even number, 10.



Can you find a solution where all four edges have different sums that are all even?

Can you find a solution where all rows, columns and diagonals sum to different even numbers?

Solutions next week

Far off

Large planets have more distant horizons than small ones, but lower mountains due to higher gravity. On which would you see farther?

Chris Daniel
Glan Conwy, Conwy, UK
The maximum height of a mountain doesn't appear to be closely related to the size of the planet, but views from the highest point are generally greater the larger the planet.

The four rocky planets of the solar system are Mercury, Venus, Earth and Mars. Of these, Mars is the third largest after Earth and Venus, but it has by far the highest mountain, Olympus Mons, at over 24,000 metres tall. From its peak, the distance to the horizon, if not obscured by Mars's red dust, would be 404 kilometres, the most extensive view in the solar system.

Skadi Mons on Venus is less than half the height of Olympus Mons, at 11,520 m, but because Venus is 80 per cent bigger than Mars, the distance potentially visible from that peak is only a little less at 374 km. By comparison, on Earth, about 5 per cent bigger than Venus, climbers on Everest's 8800-metre summit can see as far as 335 km. Mercury, the smallest of the planets, is just over a quarter of Earth's size, and its highest peak, Caloris Montes, is only 3000 m, so if you could stand on top of it, the horizon would be 121 km away.

"From the peak of Mars's mountain Olympus Mons, the distance to the horizon would be 404 kilometres"

Jupiter's moon Io has the fourth most distant vistas in the solar system at 258 km, seen from its highest mountain at 18,000 m.

On the asteroid Vesta, orbiting between Mars and Jupiter, there is a large impact crater whose rim is up to 25 km tall, making it possibly higher than Olympus Mons. Vesta has a diameter of just 529 km, however, so the distance visible from its peak is only 118 km.

The gas giants of the outer solar system can't be said to have mountains, but if one were possible on the largest, Jupiter, which has a diameter of nearly 140,000 km, it would only need a peak of 1167 m for you to be able to see the same distance as from the top of Olympus Mons on Mars.

Martin Gellender
Brisbane, Australia
The distance that you can see to the horizon on a smooth, featureless plain varies with the square root of the radius of the planet and the height of the observer above "ground level". So, on a featureless spherical rocky planet, the distance to the horizon would double if the radius were four times as much (although the planet would have 64 times the mass and four times the gravity at its surface).

The rocky planets in our solar system do have some flat, featureless areas (lava flows and oceans), but much of their surface is covered with mountains, hills and impact craters. The height of these features varies widely and doesn't simply correlate with the gravity of the planet. So, the distance you could see to the horizon would depend largely on the local topography and the elevation of the observer.

Mike Follows
Sutton Coldfield, West Midlands, UK
According to a model I have come up with, we would see farthest on planets whose average density is smallest while still being rocky. This is because the maximum distance to the horizon that could be seen from a planet's highest mountain is inversely proportional to the planet's average density.

The distance in kilometres is about 1.6 million divided by the density of the planet (expressed in kilograms per cubic metre). This certainly works for Venus, Earth and Mars, giving maximum distances to the horizon of about 290, 295 and 410 km that can be seen from the tallest mountains that could exist in theory, given the following assumptions.

My model assumes that all the mountains are made of granite with a density of 2700 kg/m^3. It also assumes that each planet has a uniform density, and it takes no account of mountain-building mechanisms or erosion or even the refraction of light by any atmosphere that might be present.

As a mountain gets taller, the weight acting down on its base increases until the rock there starts to deform or melt. The weight of an object on the surface of a planet increases with gravitational field strength.

This means that planets with bigger gravitational field strengths have shorter mountains because the weight required to deform the rock at their base is achieved with less mass.

Everest is two and a half times shorter than Olympus Mons on Mars because the gravitational field strength on the surface of Earth is just over two and a half times what it is on the surface of Mars.

All else being equal, we should see farther from a taller mountain. However, a smaller value for the gravitational field strength at its surface implies a smaller planet, where the ground falls away over a shorter distance, reducing how far we might otherwise have seen.

ALLEN CREATIVE/STEVE ALLEN/ALAMY

Could a visitor to a far-future Earth work out if a human or another ape built a structure?

This week's new questions

Whodunnit? **If visitors to our planet in millions of years found fossils of a *Homo sapiens* and another great ape in an elaborate tomb, would they be able to prove which one built it?** ***Tom Frost****, Brisbane, Australia*

Take a breath **How did marine reptiles such as ichthyosaurs breathe?** ***Andrew Hawkins****, Peaslake, Surrey, UK*

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Tom Gauld
for New Scientist

Child's play

At what age would a human child be capable of surviving in the wild? (continued)

Peter Bursztyn
Barrie, Ontario, Canada
Let your imagination run wild. Imagine a teenager strolling down a street after school. Their head is down, thumbs glued to their cellphone. Their peripheral vision is good enough to avoid bumping up against "street furniture" like bus shelters.

Now, imagine the buildings change to a forest scene. The pavement becomes a dirt path. What finally alerts the teenager to the change is that their signal fades. Their head pops up and they take in the new scenery with some dismay.

If their parents had taken them on canoe trips, they might be accustomed to gathering firewood and cooking on a campfire. How would they light this fire? Perhaps they have some matches or a lighter – good for a few days. How about tinder? Would they have ever learned to gather the right type of lichen – and dry it – to work as tinder? Is there birch bark nearby?

"My guess is that a typical child of today is less well-equipped to survive in the wild than the octogenarian writing this"

So, the fire is lit – somehow – but what to cook on said fire? Does our teenager know how to set a trap for a rabbit or catch a pigeon or a fish (but without string or a hook)? Perhaps they could sneak up on an unsuspecting bird at night, when they typically don't fly.

How to kill this bird and pluck its feathers? Is there a Swiss Army knife in the teen's pocket? Is the blade sharp enough to butcher the animal? How about looking for wild vegetable foods? What is the likelihood that there are wild carrots or some primitive brassica (cabbage) growing nearby? Our teenager has no pot, so these foods would need to be speared onto a sharpened stick and held above the flames.

Assume the above has been accomplished and they have a relatively full belly. The next day dawns. "How do I get out of here?" The chances of having a compass are minuscule, and which direction would they go "in the "wild"? Where indeed is the nearest settlement?

As it happens, their Swiss Army knife has a small saw, so they could cut finger-size branches to create a lean-to. (Such saws tend to be sharp but tiny and not particularly easy to use.) They could gather conifer branches to create a thatch roof as well as walls for their shelter.

I remember creating a comfy bed out of conifer branches in my youth. However, even with my long experience canoeing, hiking and camping, I have never tried to truly "live off the land", so I would be unlikely to stay alive for long.

My guess is that a typical child of today is less well-equipped to survive in the wilderness than is the unusually experienced octogenarian writing this. ▮

Answers

Quick quiz #254 *Answers*

1 The Köbner phenomenon
2 Aphids
3 1969
4 Between the small and large intestine
5 The calyx

Cryptic crossword #136 *Answers*

ACROSS 1 Collider, **5** Barb, **8** Vista, **9** Habitat, **11** Hit the target, **13** Rusted, **15** Skinny, **17** Event horizon, **20** Sunbeam, **21** Hiker, **22** Pump, **23** Bassinet

DOWN 1 Cave, **2** Lassi, **3** Imax theatre, **4** Echoed, **6** Antigen, **7** Bath toys, **10** Black lights, **12** Creeps up, **14** Sternum, **16** Roomba, **18** Oaken, **19** Brut

#21 Digit gangs *Solution*

For the largest possible sum of ABC + DE + FGH + IJ, we need to assign the two largest digits (9 and 8) to the hundreds digits, A and F, then the next largest to the tens digits, making sure the four smallest digits are in the units position. For example, 973 + 51 + 862 + 40. It doesn't matter what order you arrange these in; the sum will always be 1926. To get the largest outcome from (ABC × DE) + (FGH × IJ), we can maximise one of the two products by using the 8 and 9 as the first digits, so the largest result is (851 × 94) + (630 × 72) = 125354. Also this can be achieved in a few other ways: (720 × 63) + (851 × 94), (851 × 94) + (630 × 72) and (851 × 94) + (720 × 63). There are 198 ways to get a difference of exactly zero from (ABC × DE) – (FGH × IJ), including (135 × 96) – (270 × 48) and (972 × 15) – (486 × 30).

Head in the sand

The known risks – corporate, financial, personal, sexual – of starting an ostrich farm are perhaps not so well known in New England as in old England.

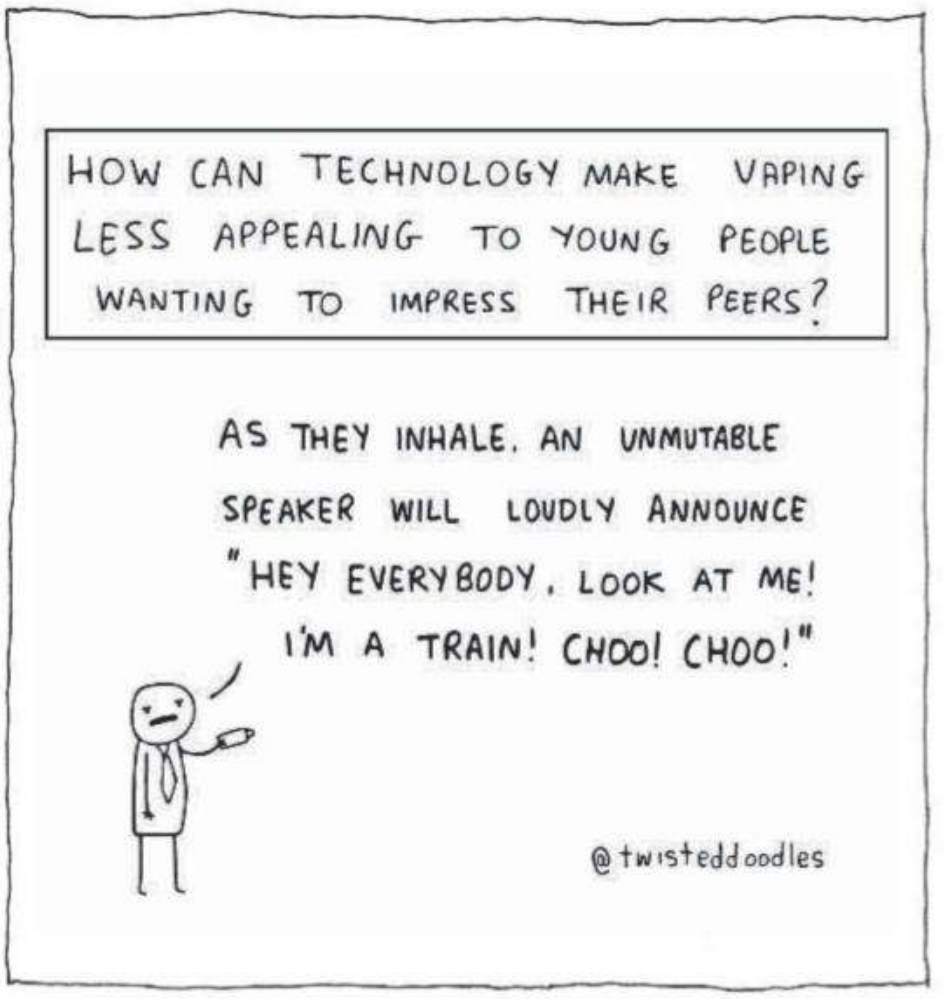
The *Boston Globe* profiled an entrepreneur who has begun raising ostriches in New Hampshire, a small state in New England. "Move over filet mignon," says the headline, "meet the man who wants to make ostrich meat a staple." The article then goes on to say how "A self-described 'city boy' created an ostrich farm in rural N.H".

The 2002 Ig Nobel Prize in biology was awarded to Norma Bubier, Charles Paxton, Phil Bowers and D. Charles Deeming, for their report "Courtship behaviour of ostriches (*Struthio camelus*) towards humans under farming conditions in Britain".

The four researchers had been asked to investigate why ostriches at British farms were failing to produce enough baby ostriches. Careful observation made clear what was happening: ostriches hatched on British farms often found their two-armed companions to be more sexually attractive than their two-winged companions.

Feedback has learned, from conversations with one of the scientists, that some of the ostriches showed a special yearning for that particular scientist. Feedback sends good wishes, along with what Americans call "hopes and prayers", to the New Hampshire farmer.

Twisteddoodles *for New Scientist*


HOW CAN TECHNOLOGY MAKE VAPING LESS APPEALING TO YOUNG PEOPLE WANTING TO IMPRESS THEIR PEERS?
AS THEY INHALE, AN UNMUTABLE SPEAKER WILL LOUDLY ANNOUNCE "HEY EVERYBODY, LOOK AT ME! I'M A TRAIN! CHOO! CHOO!"
@twisteddoodles

Got a story for Feedback?

Send it to feedback@newscientist.com
or New Scientist, 9 Derry Street, London, W8 5HY
Consideration of items sent in the post will be delayed

Coffee aromatherapy

Praewpat Pachimsawat, Manita Tammayan, Thi Kim Anh Do and Nattinee Jantaratnotai devised a fairly simple way to deliver aroma to dental students. Opting not to infuse an entire room with a general miasma, they sought to achieve "personal coffee aroma distribution".

Personal coffee aroma distribution, desirable though it is, wasn't the ultimate purpose. This project had a different, clearly stated goal: "[We] aimed to investigate the potential reduction of academic stress related to a graded oral presentation in postgraduate dental students using coffee aromatherapy."

The story appears in the study "The use of coffee aroma for stress reduction in postgraduate dental students". One photo caption gives the essence of what the team did: "Coffee essential oil (1 mL) was dropped onto a cotton pad at 5:100 concentration and placed near the nose with a lanyard and a personal fan to help distribute the aroma."

The caption to a subsequent photo conveys some of the project's drama: "The coffee essential oil was placed around a mannequin similar to an experimental setting with the tube set at 20 cm from the coffee aroma source. The tube (A) for transferring the aroma was connected to the e-nose machine (B)." The team reports a modicum of success in its stated aim.

Dental stress

Another reason dental students can feel stress becomes evident when one sees the title of the study "Influence of dental students' dietary habits on tooth color" by Ayse Tugba Erturk Avunduk, Hande Filiz and Esra Cengiz Yanardağ.

They report making two discoveries: "Females have lighter teeth than males" and "The increase in the amount of consumption of the evaluated staining beverages is one of the factors that cause the tooth colors to become darker".

Circumcision for nudists

Feedback congratulates the anonymous author of a news release from Brandon University in Canada for persuading their editor to run the item that bears this all-caps headline: "BU PROF RECOGNIZED FOR OUTSTANDING RESEARCH ON ANTI-CIRCUMCISION DEBATES".

The first sentence may have been irresistible once it entered the writer's mind. It says: "A respected Brandon University professor known for his cutting-edge work studying masculinity has received major recognition for one of his recent academic articles."

Then come some technical details of interest to specialists: "[Jonathan Allan's] article, 'Reading anti-circumcision [activism] in Clothed with the Sun: The Quarterly Journal of Clothes-Optional Living' ... analyzes a debate about circumcision that unfolded in a nudist magazine, beginning with a 1986 article arguing for a natural foreskin as well as the letters to the editor that followed." Then come some words of praise from the editor who published Allan's research: "Jonathan's work impressed us all because it is well-written and well-researched, and a great example of how to explain complex issues for a broad range of readers."

Then, at the end, come some clarifying words for laypersons keen to read the study and learn more: "Please note that the article discusses and includes images about nudity and male genitals."

Pharma drama

Feedback savours the panoply of emotions delivered to television viewers by an ad campaign for a drug that has the non-evocative name Bimzelx.

"Most people got 100 per cent clear skin", says a voice-over, preparing us for the drama that arrives seconds later when a second voice-over adds: "Serious side effects, including suicidal thoughts and behaviour, infections and lower ability to fight them, liver problems and inflammatory bowel disease, have occurred." ▮

Marc Abrahams

Discovery Tours

NewScientist

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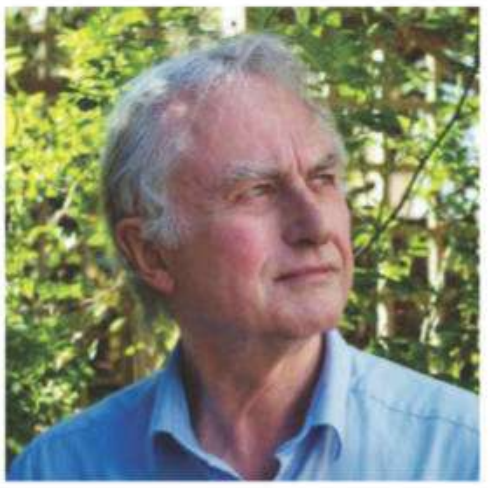

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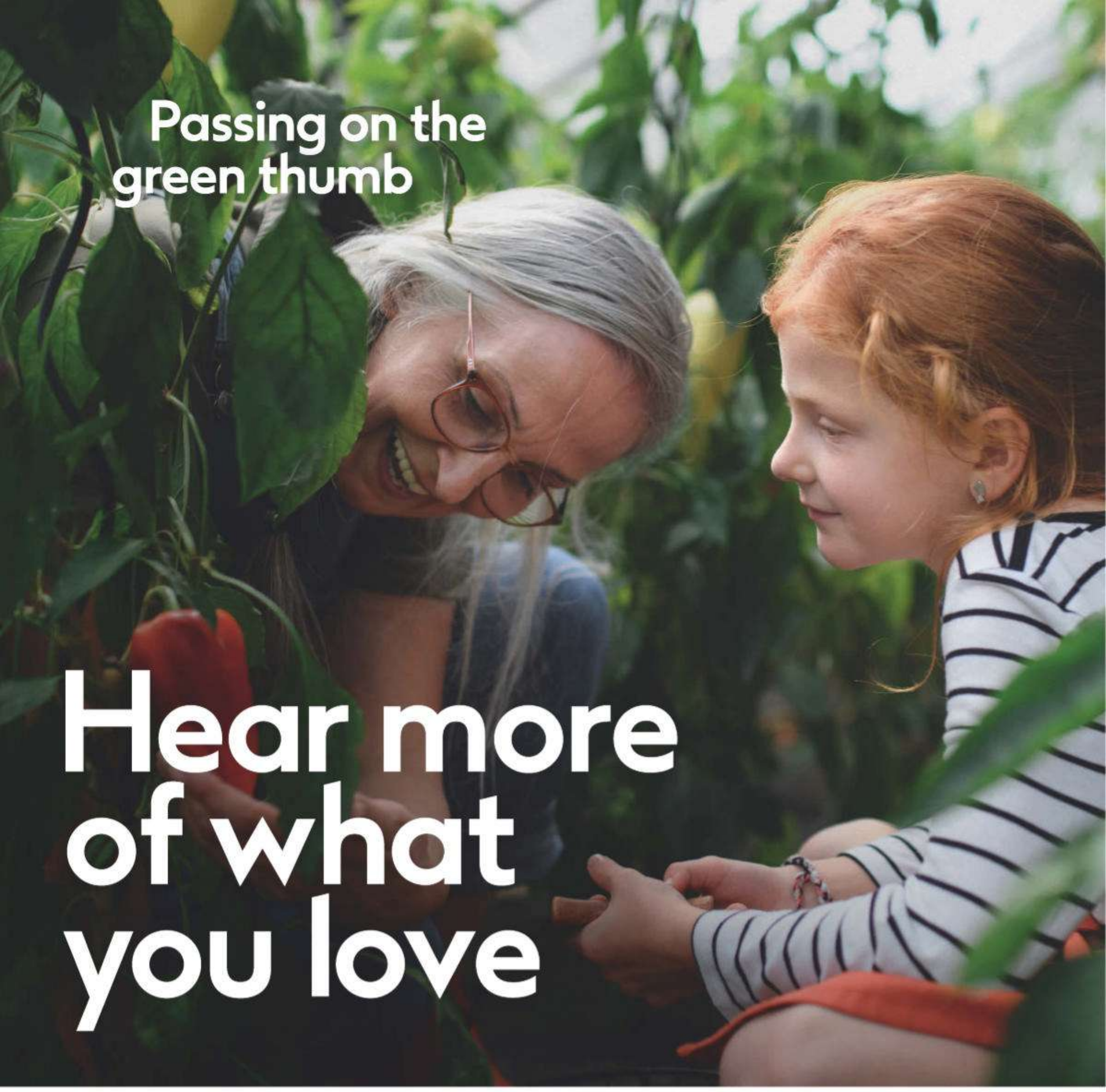

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